The double burden of overweight/obesity and anaemia in low- and middle-income countries

by

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A Doctoral Thesis

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I would like to dedicate this thesis to all the strong and compassionate women who, in one way or another, have inspired and encouraged me, in my personal and professional life, to get to this point.

To my grandma, my lil sis, and my parents.

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"Because when you lift up women, you lift up humanity" (Melinda Gates)

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And now, onto new adventures!

Declaration

This thesis is submitted to the University of Warwick in support of my application for the degree of Doctor of Philosophy. It has been composed by myself and has not been submitted in any previous application for any degree.

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Dissemination and publications

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Abstracts

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Abstract

Overweight/obesity is increasing rapidly in low-and middle-income countries (LMICs), where forms of undernutrition remain high. Women of reproductive age and children living in LMICs are largely affected by anaemia, which is one of the 2025 global nutrition targets; however, its prevalence has remained stagnant over the past decades. As a result, different forms of malnutrition coexist at different levels: the double burden of malnutrition (DBM). Yet, the coexistence of overweight/obesity and anaemia had not being comprehensively investigated to date. Therefore, this thesis aimed to understand the epidemiology of the double burden of overweight/obesity and anaemia among adult women, adolescent girls and children living in LMICs. Data from the Demographic and Health Surveys (DHS) were employed for the analyses. Firstly, prevalence estimates were calculated at the population, household, and individual levels. Secondly, stratified analyses of the intra-individual and intra-household DBM were performed by household wealth, education level, area of residence, and sex. Lastly, trends were documented for the magnitude and inequalities of the intra-individual DBM among adult women. Overall, the intra-individual DBM was common among adult women and low among children; whereas among adolescent girls the overall pooled prevalence was 1/3 than that of adult women. At the household level, the DBM was high, primarily driven by maternal overweight/obesity and childhood anaemia. Important differences were identified by sociodemographic characteristics for the intra-individual DBM among adult women and adolescent girls, and maternal overweight/obesity and childhood anaemia; with higher prevalence estimates among those in the wealthiest groups, higher education levels and in urban areas. The trend analyses yielded a modest increase in the intra-individual DBM among adult women over the past two decades, which occurred in parallel with an overall rise in overweight/obesity and a decrease in anaemia. Due to the high heterogeneity of results obtained for the different LMICs, recommendations to address the DBM should be context-specific. The findings presented in this thesis can be used by policy makers to inform double-duty actions and accelerate progress towards the 2025 global nutrition targets.

Abbreviations

AARC	Average annual rate of change
ADO	Adolescents
AFRO	African WHO region
AR	HIV testing Recode
AzNS	Azerbaijan Nutrition Survey
BMI	Body Mass Index
BR	Births Recode
BRINDA	Biomarkers Reflecting Inflammation and Nutrition Determinants of Anemia
CI	Confidence interval
CIX	Concentration index of inequality
CR	Couples Recode
DBM	Double burden of malnutrition
DDA	Double-duty action
DHS	Demographic and Health Surveys
DRC	Democratic Republic of the Congo
EAs	Enumeration areas
EMRO	Eastern Mediterranean WHO region
ENNyS	Encuesta Nacional de Nutrición y Salud
ENDS	Encuesta Nacional de Demografía y Salud
ENDES	Peruvian National Demographic and Family Health Survey
EDNP	Energy-dense nutrient-poor
ENS	Encuesta Nacional de Salud
ENSANUT	National Survey of Health and Nutrition
ENSIN	Encuesta Nacional de la Situación Nutricional en Colombia
ENSMI	Encuesta Nacional de Salud Materno Infantil
ESA	Eastern and Southern Africa
EURO	European WHO region
FAO	Food and Agriculture Organisation of the United Nations
GC	Geospatial Covariates
GE	Geographic Data
GNI	Gross national income
Hb	Haemoglobin levels
HBSC	Health Behaviour for School-Aged Children Project
HR	Household Recode
HW	Height and Weight

ICN	International Conference on Nutrition
IR	Individual (Women's Recode)
IRB	Institutional Review Board
KR	Kids Recode
LI	Low-income country
LMI	Lower-middle-income country
LMICs	Low- and middle-income countries
MICS	Multiple Indicator Cluster Surveys
MNS	Micronutrient survey
NFHS	National Family Health Survey
MR	Men's Recode
NCDs	Non-communicable diseases
NNS	Mexican National Nutrition Survey
OB	Obesity
OW	Overweight
OWOB	Overweight/obesity
PAHO	Americas WHO region
pp	Percentage points
PR	Household members (or Persons Recode)
PSC	Pre-school children
PSUs	Primary sampling units
RII	Relative index of inequality
SC	School children
SD	Standard deviation
SEARO	Southeast Asian WHO region
SII	Slope index of inequality
SEANUTS	South East Asian Nutrition Survey
STP	Sao Tome and Principe
UMI	Upper-middle-income country
UN	United Nations
USAID	United States Agency for International Development
WCA	Western and Central Africa
WHO	World Health Organisation
WI	Wealth Index
WPRO	Western Pacific WHO region
WRA	Women of reproductive age

Glossary

Adolescent girls	Female individuals aged 15-19 years old.
Adult women	Female individuals aged 20-49 years old.
Anaemia	A condition in which the number of red blood cells (or the haemoglobin concentration within them) is lower than normal. The majority of cases of anaemia are believed to have a nutritional cause (e.g., iron deficiency); however, its aetiology is multifactorial and context- specific.
Children	Both, boys and girls aged 0-59 months.
Double burden of malnutrition	The coexistence of overweight/obesity and anaemia within individuals, households, and populations at a specific point in time or within the life-course.
Intra-household DBM	Overweight/obesity and anaemia coexisting within households in mother-child dyads. In this thesis it refers to: 1) maternal overweight/obesity and childhood anaemia, 2) maternal anaemia or childhood overweight/obesity, or 3) total intra-household DBM (presence of any of the previous two forms).
Intra-individual DBM	A woman, adolescent girl or child simultaneously affected by overweight/obesity and anaemia. Also referred in this thesis as the co-occurrence or concurrent overweight/obesity and anaemia.
Low-and middle-income countries	As per the World Bank definition using the most recent data from the year 2020, LMICs, are countries with a GNI per capita below $12,696. This includes low-income, lower-middle income, and upper-middle income economies.
Overweight/obesity	The abnormal or excessive fat accumulation that may impair health, causing nutrition-related NCDs, such as type 2 diabetes, cardiovascular diseases, stroke and some types of cancer.
Population-level DBM	Overweight/obesity and anaemia are prevalent in LMICs. Bivariate prevalence estimates of both forms of malnutrition.

CHAPTER 1

Introduction

Malnutrition, defined as the nutritional deficiencies, excesses or imbalances of macronutrients and micronutrients, is the leading cause of poor health globally, affecting individuals irrespective of their location, age, wealth or gender (Swinburn et al., 2019; Development Initiatives, 2021). Despite progress made in recent years to tackle malnutrition in all its forms, the latest data provided in the 2021 Global Nutrition Report still shows an unacceptably high burden of undernutrition, overweight/obesity and micronutrient deficiencies (Development Initiatives, 2021). Currently, one in five (22%) children under-5 has stunting, 6.7% have wasting and 5.7% have overweight or obesity. Concurrently, around two in five adults are living with overweight/obesity (40.8% of women and 40.4% of men); while undernutrition affects 9.1% of women and 8.1% of men. Anaemia remains a threat to women and girls globally, with 29.9% of the female population aged 15-49 years old affected (36.5% of pregnant and 29.6% of non-pregnant women). Among children under-5, the prevalence of anaemia is estimated at 39.8% (WHO, 2019). Prevalence estimates of the different forms of malnutrition vary widely across and within countries and between regional groups (Development Initiatives, 2021). In low- and middle-income countries (LMICs), forms of undernutrition persist, accounting for 45% of deaths among children under-5 (WHO, 2021a). Simultaneously, rates in overweight/obesity are rising rapidly in these countries across all age groups, accompanied with an increase in non-communicable diseases (NCDs) such as diabetes, cardiovascular diseases and some types of cancer, among others (WHO, 2021b). Rapid increases in overweight/obesity across LMICs are being driven primarily by a sequence of interlinked epidemiological changes, which encompass the nutrition, epidemiological and demographic transitions (WHO, 2017a). The nutrition transition is characterised by a shift in dietary patterns and nutrient intakes, from traditional towards more energy-dense diets, and physical activity patterns, in the context of economic, political and social development, together with globalisation and urbanisation (Popkin, 2002; Popkin, 2006). The aforementioned transitions are responsible for gradual increases in population health, but also a rise in overweight/obesity and nutrition-related NCDs (Shrimpton and Rokx, 2012). As a result, undernutrition and overweight/obesity overlap within LMICs; phenomenon referred to as the double burden of malnutrition (DBM).

The World Health Organisation (WHO) defines the DBM as the coexistence of undernutrition (i.e., stunting, wasting, underweight, thinness and micronutrient deficiencies) alongside overweight, obesity and diet-related NCDs, that occurs within individuals, households and populations at a specific point in time or within the life-course (WHO, 2017a). According to this definition, the DBM can manifest at three different levels (i.e., individual, household and population), and in two temporal dimensions (i.e., at one point in time or through the life-course). At the individual level, the DBM can be observed when an individual simultaneously develops two or more forms of malnutrition, such as overweight or obesity along with stunting or a micronutrient deficiency. As per the above definition, this intra-individual coexistence of multiple forms of malnutrition does not necessarily occur at one point in time; it can be temporarily separated. An example of the latter would be overweight or obesity in an adult who was previously affected by stunting from chronic undernutrition during childhood. At the household level, multiple family members are affected by different forms of malnutrition, for example, a child is living with anaemia and a mother, father, sibling, grandparent, or any other family member is living with overweight or obesity. At the population level, forms of undernutrition and overweight, obesity or nutrition-related NCDs are prevalent in the same community, region or nation. The different components of the DBM are presented in **Table 1.1**.

All forms of malnutrition have serious and lasting developmental, economic, social and medical consequences for individuals, their families, the communities where they live and countries; some of which are highlighted in **Table 1.1**. Moreover, many of the problems associated with the DBM are manifested across the life course and throughout generations (Shrimpton and Rokx, 2012; Hoffman et al., 2017). For example, overweight/obesity in mothers is associated with elevated fetal adiposity, which can lead to macrosomia and overweight/obesity across childhood and later in life; whereas undernutrition among mothers can result in low birth weight and undernutrition in their offspring (Wells et al., 2020). These apparent separate intergenerational cycles are interlinked due to the nutrition transition and rapid changes in food systems. Multiple studies have shown that undernutrition early in life can predispose individuals to overweight/obesity and nutrition-related NCDs later in life, particularly as countries develop and children grow up in obesogenic environments (Wells et al., 2020). The latter might also be a result of physiological

Table 1.1. Summary of main forms of malnutrition[1].

Concept	Description	WHO definition/measurement
Stunting	Also known as chronic undernutrition or short stature. It is a form of growth failure which develops early in life, normally within the first two years of life, over a long period of time when growing with limited access to food, health (e.g., repeated infection) and care (e.g., inadequate psychosocial stimulation). Stunting might lead to cognitive impairments, impaired brain function and poor school performance. Children who are stunted are also more likely to be wasted.	♦ Birth to 5 years old: length/height-for-age < -2SD ♦ 5 to 19 years old: height-for-age < -2SD ♦ >19 years old: <145cm (short stature)
Wasting/thinness	Wasting in children under-5 and thinness in school age children and adolescents are forms of acute undernutrition, characterised by a rapid deterioration in nutritional status over a short period of time. Acute undernutrition poses a high risk of death for children under-5. Children who are wasted are also more likely to be stunted.	♦ Birth to 5 years old: weight-for-height < -2SD (wasting) ♦ 5 to 19 years old: BMI-for-age < -2SD (thinness)
Underweight	Form of undernutrition characterised as body weight, or weight for height, too low for a person' s age. In the adult population, underweight is defined as a BMI less than 18.5 kg/m^2. A low BMI (<16 kg/m^2), increases the likelihood of ill health, poor physical performance, lethargy and even death.	♦ >19 years old: BMI <18.5 kg/m^2
Micronutrient malnutrition	Also referred to as hidden hunger, it is a suboptimal nutritional status caused by insufficient intake and/or absorption of one or more vitamins or minerals (e.g., vitamin A, iron, iodine, zinc, and vitamin B12). Micronutrient deficiencies can result in poor physical and mental development in children, vulnerability or exacerbation of disease, mental retardation, blindness and general losses in productivity and potential. Deficiencies of certain micronutrients can also lead to anaemia, and thus, it is generally used as a proxy for micronutrient deficiencies in the absence of micronutrient data. Anaemia is defined as a condition in which the number of red blood cells (or the haemoglobin concentration within them) is lower than normal. The majority of cases of anaemia are believed to have a nutritional cause (e.g., iron deficiency); however, its aetiology is multifactorial and context-specific. Although less common than deficiencies, excess of some micronutrients may lead to adverse effects (i.e., micronutrient toxicity).	♦ 6 to 59 months: Hb <110 g/L (anaemia) ♦ 5 to 11 years old: Hb <115 g/L (anaemia) ♦ >12 years old: Hb <120 g/L (anaemia non-pregnant) ♦ >12 years old: Hb <110 g/L (anaemia pregnant)
Overweight/obesity	The abnormal or excessive fat accumulation that may impair health, causing nutrition-related NCDs, such as type 2 diabetes, cardiovascular diseases, stroke and some types of cancer.	♦ Birth to 5 years old: BMI-for-age (or weight-for-age) >2SD (OW) and >3SD (OB). ♦ 5 to 19 years old: BMI-for-age >1SD (OW) and >2SD (OB) ♦ >19 years old: BMI >25 kg/m^2 (OW) and >30 kg/m^2 (OB)

[1]Sources: WHO, 2006; WHO, 2007; WHO, 2011; Chaparro & Suchdev, 2019; WHO, 2020; Development Initiatives, 2021.

changes, whereby children with undernutrition (e.g., stunting) accumulate more fat mass and less lean body mass than healthy children (Martins et al., 2004; Hoffman et al., 2007; Wells, 2019).

Despite the detrimental consequences of malnutrition, the path for the global health community to acknowledge the challenge of the DBM in LMICs has been slow. The concept of the DBM was coined, for the first time in 1992, at the International Conference on Nutrition (ICN), held by the Food and Agriculture Organisation of the United Nations (FAO) and the WHO. The DBM represented a “new paradigm” to collaboratively address all forms of malnutrition, by acknowledging the simultaneous presence of different forms of malnutrition within countries. This included the recognition of overweight/obesity as a global challenge, once considered sorely a problem of high-income countries and affluence (Shrimpton and Rokx, 2012). It is now known, that as countries develop economically, the proportion of overweight/obesity increases among the poorest groups as well (Templin et al., 2019). Nevertheless, in LMICs, national nutrition policies and programmes have historically focused on forms of undernutrition, leaving overweight/obesity unattended. Moreover, the wrong belief that undernutrition and overweight/obesity are two separate problems has led, for far too long, to siloed approaches. The latter has resulted, in some instances, in unintended harmful consequences, including the promotion of overweight/obesity, and consequently, a rise in nutrition-related NCDs (Fernald et al., 2008; Hawkes et al., 2017).

In 2012, the World Health Assembly Resolution 65.6 endorsed a *Comprehensive implementation plan on maternal, infant and young child nutrition* to accelerate global action towards addressing all forms of malnutrition, which introduced six global nutrition targets (WHO, 2014a). The novelty of this plan lied on the inclusion of childhood overweight as a nutrition target for the first time, alongside forms of undernutrition. The World Health Assembly global nutrition targets aim to, by 2025: (1) achieve a 40% reduction in the number of children under-5 who are stunted; (2) achieve a 50% reduction of anaemia in women of reproductive age (WRA); (3) achieve a 30% reduction in low birth weight; (4) ensure that there is no increase in childhood overweight; (5) increase the rate of exclusive breastfeeding in the first six months up to at least 50%; and (6) reduce and maintain childhood wasting to less than 5%. Another global target of interest for the DBM is to halt the rise of obesity among the adult population, which is part of a list of targets to reduce NCDs (WHO, 2013a). The latest data show that no country is on course to halt the rise of adult obesity and only one country is on course to reduce the prevalence of anaemia among WRA (Development Initiatives, 2021). Some progress has been made towards achieving the wasting, stunting, exclusive breastfeeding and low birth weight targets, with 57, 53, 35 and 15 countries on course, respectively; while 105 countries are on course to meet the target of childhood overweight (Development Initiatives, 2021). Further, the status of malnutrition in all its forms has likely worsened globally as a response of the recent Covid-19 pandemic, adding to the challenge of meeting the global nutrition targets and the Sustainable Development Goal 2 of ending malnutrition in all its forms by 2030 (Development Initiatives, 2021; UNICEF/WHO/The World Bank, 2021). The Covid-19 pandemic is increasing the proportion of people living in extreme poverty, which may lead to a rise in hunger, in combination with the ongoing climate crises and persistent conflicts. Likewise, overweight/obesity and nutrition-related NCDs have been linked with worse Covid-19 outcomes, highlighting the importance of good nutrition for health (Hajifathalian et al., 2020; Cai et al., 2021; Gao et al., 2021). In view of this, dual burdens of malnutrition present a major opportunity for integrated action to end malnutrition in all its forms by 2030. Quantifying the extent and distribution of the DBM is the first step to achieve this, to guide the development of context-specific programmes and policies that address the full spectrum of malnutrition, while taking into account inequalities, leaving no one behind (UN, 2018).

In December 2019, the Lancet published a Series on the DBM. This *Lancet Series on the Double Burden of Malnutrition* comprised four main research articles on the magnitude, aetiological pathways and consequences for health, economic effects, common drivers of undernutrition and overweight/obesity, and potential solutions to the DBM (Nugent et al., 2020; Hawkes et al., 2020; Popkin et al., 2020; Wells et al., 2020). The first paper by Popkin et al. (2020) used nationally representative data from 126 countries to quantify the magnitude of the DBM at the three levels (i.e., population, household and individual). Yet, the latter study only included anthropometric data to their estimates, excluding anaemia, which might have resulted in an underestimation of the full extent of malnutrition globally (Osendarp et al., 2020). Therefore, this PhD thesis focuses on the coexistence of overweight/obesity and anaemia, to comprehensively investigate its magnitude, inequalities, and changes over time in LMICs. To achieve this goal, the present thesis is structured as follows:

Chapter 2 provides an overview of the literature regarding the double burden of overweight/obesity and anaemia from LMICs and highlights gaps in research that informed the development of aims and objectives. This chapter concludes that there was indeed a dearth of evidence on the magnitude and distribution of the double burden of overweight/obesity and anaemia, particularly at the individual and household levels; and that no studies documenting trends in the DBM at these two levels were identified.

Chapter 3 presents the overall aim and objectives of the PhD thesis.

Chapter 4 introduces the database utilised in this thesis (the Demographic and Health Surveys) and expands on the methodology employed throughout the empirical chapters, including a description of the datasets, study population, data management, and the process of data analysis.

Chapter 5 reports findings on the magnitude and distribution of the double burden of overweight/obesity and anaemia at the individual level among adult women, adolescent girls and children living in 52 LMICs. Estimates at the population level are also reported in this chapter. This analysis shows that the magnitude of the intra-individual DBM is common among adult women living in LMICs, with higher prevalence estimates among those in the wealthiest groups, higher education levels and urban residents; although important variations across countries and within WHO regions are observed for the three age groups. The overall pooled prevalence of intra-individual DBM among adolescent girls and children is approximately 1/3 and 1/4, respectively, than that of adult women.

Chapter 6 presents findings on the magnitude and distribution of the double burden of overweight/obesity and anaemia at the household level among mother and child dyads living in 49 LMICs. The analysis yielded a high prevalence of intra-household DBM, primarily led by the form maternal overweight/obesity and childhood anaemia. The latter was particularly prevalent among those in the wealthiest groups, higher maternal education levels and urban residents; although with some variations across WHO regions.

Chapter 7 compares findings on wealth and education-related inequalities in the distribution of the intra-individual and intra-household DBM by use of simple (i.e., inequality gaps) versus complex (i.e., slope index of inequality) measures of inequalities. Overall, similar findings are observed when using both measures; however, it is argued that complex measures of inequality might be a better choice when investigating inequalities in the DBM.

Chapter 8 documents trends in the magnitude and inequalities of the intra-individual double burden of overweight/obesity and anaemia among adult women living in 33 LMICs. The data indicates that concurrent overweight/obesity and anaemia among adult women seems to be increasing modestly in the majority of LMICs included to the analysis. This upward trend is evident across all subgroups, but particularly among those in the three middle wealth groups, women with no education and those living in capital cities or rural areas.

Chapter 9 provides a summary of key findings, alongside an overall discussion of the thesis. In this chapter, the original contribution to knowledge is outlined and the overarching methodological considerations are discussed, with suggestions for public health, as well as research, leading to the conclusion of the thesis.

CHAPTER 2

The coexistence of overweight/obesity and anaemia across the life-course: an overview of the literature from low- and middle-income countries

2.1. Chapter overview

This chapter provides an overview of the existing literature and highlights research gaps that informed the development of the thesis aims and objectives. The approach utilised for the review (i.e., search strategy, process of inclusion criteria, data extraction and data synthesis) is described first; followed by the review findings, which are presented in two parts. The first focuses on the magnitude and distribution of the double burden of overweight/obesity and anaemia. This section is divided into seven sub-sections, including and overall description of the findings, and then, by the six WHO regions (i.e., African, Eastern Mediterranean, European, Americas, Southeast Asian and Western Pacific). The second summarises findings from studies included in part I related to the association between both components of the double burden (i.e., overweight/obesity and anaemia). Throughout this chapter, tables are employed to map the literature identified on the double burden of overweight/obesity and anaemia at the different levels from LMICs and to synthesise the main characteristics and key findings of studies included.

2.2. Search strategy and inclusion criteria

PubMed database was searched using key words specific to this thesis. The search was kept broad to identify any academic publication that included the two outcomes of interest. The following search terms were used: overweight, obesity, anaemia and anemia. The search was restricted to countries classified as low-and middle-income (i.e., low-income, lower-middle-income and upper-middle-income countries) by the World Bank Income classification (https://epoc.cochrane.org/lmic-filters). After a first preliminary look at the available data, the following terms were added (NOT Boolean Operator used): bariatric, gastrectomy and surgery. The search was restricted to academic papers published from inception to the 1st of June 2021, to highlight the existent gaps in research before the publication of the first manuscript arising from this thesis. No additional filters (e.g., language, article type, etc) were used at this point, resulting in a total of 910 records. The full search and how Boolean terms were utilised can be observed in **Table 2.1**.

Table 2.1. PubMed search.

Search #	Searches	Filters	Results
18	#16 NOT #17	from 1000/1/1 - 2021/6/1	910
17	surgery[Title]	from 1000/1/1 - 2021/6/1	383,665
16	#14 NOT #15	from 1000/1/1 - 2021/6/1	925
15	gastrectomy[Title]	from 1000/1/1 - 2021/6/1	15,446
14	#12 NOT #13	from 1000/1/1 - 2021/6/1	947
13	Bariatric[Title]	from 1000/1/1 - 2021/6/1	11,273
12	#7 AND #10	from 1000/1/1 - 2021/6/1	989
11	#7 AND #10		1,028
10	#8 OR #9		7,297,422
9	List #2 from: https://epoc.cochrane.org/lmic-filters		7,297,337
8	List #1 from: https://epoc.cochrane.org/lmic-filters		6,644,131
7	#3 AND #6		2,433
6	#4 or #5		239,839
5	anemia		239,839
4	anaemia		239,839
3	#1 or #2		423,376
2	obesity		407,384
1	overweight		275,971

An Excel spreadsheet was created, containing the 910 records retrieved from the search, with the following information: title, abstract, authors, citation, first author, journal/book, publication year, and DOI. Then, two tabs were added into the Excel file: one for title/abstract screening and one for full text screening. The main criteria for inclusion encompassed:

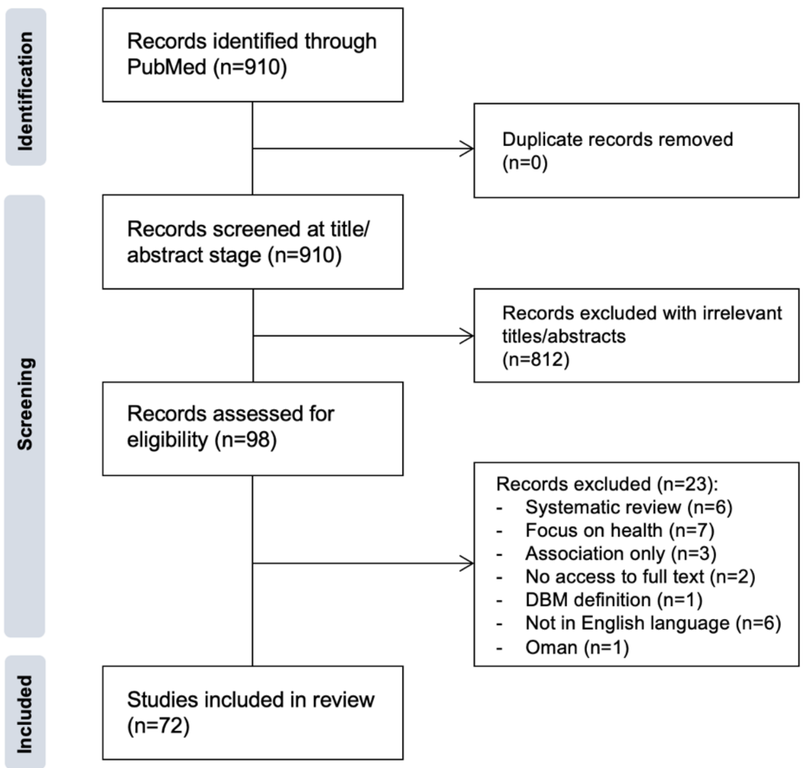
- type of study: cross-sectional;
- population: women (15-49y), adolescents (10-19y) or children (0-10y);
- outcomes: overweight/obesity and anaemia;
- context: LMICs, as defined by the World Bank Income classification.

According to the above-mentioned inclusion criteria, studies that only focused on one form of malnutrition but not the other (e.g., magnitude of anaemia but not overweight/obesity) were excluded. Furthermore, studies had to include prevalence data for at least one of the age groups of interest and cover one or multiple LMICs.

Studies only focusing on women >49 years old, men, pregnant women, or population groups with a particular health condition (e.g., sickle cell disease, diabetes, renal disease, etc) were excluded. Likewise, studies that only focused on examining the association between overweight/obesity and anaemia, without presenting the magnitude of both forms of malnutrition were excluded. Systematic reviews were also excluded, but the reference list was checked to make sure that no relevant record was missing from the final list for full text screening.

Full text screening followed the same inclusion/exclusion criteria than those described for the title/abstract screening (**Figure 2.1**). Additional exclusion criteria included articles which main focus was health and not the 'double burden of malnutrition', as well as not having access to the full text. Articles that used a different definition of the DBM (i.e., coexistence of anaemia and cardiometabolic risk factors or NCDs) than the one presented in this thesis were also excluded. The definition of the DBM at the different levels is presented in the next section. Finally, due to time restrictions and to avoid review bias, articles that were not written in English (n=6) were excluded.

Figure 2.1. Flowchart showing the identification of studies via PubMed.



2.3. Data extraction and synthesis

Data extraction of included studies was conducted in a separate tab of the Excel document. For this, records included in the review were classified by WHO region, following the main categorisation used in this thesis.

Data extracted from studies included general information (i.e., author(s) and publication year); source of data, level (i.e., national or subnational) and sample size; study location (i.e., country and WHO region); DBM level at which the magnitude was calculated (i.e., population, household, or individual level); characteristics of participants (i.e., population group and age mean/range); data collection methods (i.e., overweight/obesity and anaemia measurement); micronutrient deficiencies; equity stratifiers and inequality measures used; trends; and whether studies reported association or not. This was further supplemented by a brief description of findings around the DBM magnitude, trends, and inequalities in the distribution of overweight/obesity and anaemia for every study included in the review, to help summarising findings narratively.

After data extraction was concluded, it was decided to create tables to synthesise the main characteristics of studies which are more relevant to this thesis and the objective of this review (i.e., to map the existent literature and highlight gaps in research that informed the PhD aims/objectives). The following headings were kept from the Excel file: author(s) and year, country, source of data and level, study population, DBM level, presence of stratified prevalence estimates (yes/no), presence of trends (yes/no), and micronutrient deficiencies.

For consistency, the DBM definitions employed throughout this thesis were used (**Table 2.2**), and these did not necessarily align with the DBM level described in the studies. For example, if the aim of a study was to calculate the magnitude of the DBM at the individual level, but only separate estimates for overweight/obesity and anaemia were presented, then this was categorised as population-level DBM in this review. Likewise, if a study defined the household-level as concurrent maternal overweight/obesity and childhood anaemia, but also concurrent maternal anaemia and childhood anaemia, only data for the first form was extracted.

A separate table was created to summarise the different factors (i.e., equity stratifiers) used in included studies to investigate differences in the distribution of the two forms of malnutrition across population subgroups. Equity stratifiers are variables chosen to reflect a perceived inequality, also known as "dimensions of inequality" (Carrol et al., 2021). For this review, the PROGRESS framework, developed by Evans & Brown

(2003) was utilised. PROGRESS stands for: **P**lace of residence; **R**ace (or ethnicity); **O**ccupation; **G**ender (or sex); **R**eligion; **E**ducation; **S**ocioeconomic status; **S**ocial capital. An additional category (i.e., other) was created to reflect any other factors that authors may have used to show differences in the distribution of the DBM magnitude. The latter category included: age group, region/state, refugee status, breastfeeding status, mother's nutrition status, etc.

Table 2.2. Defining the DBM at the different levels.

DBM level	Symbol	Definition
Population		- Bivariate % estimates of overweight/obesity and anaemia at the country, region, state, community, or neighbourhood level.
Household		- Maternal overweight/obesity and childhood anaemia within the same household. - Maternal anaemia and childhood overweight/obesity within the same household.
Individual		- Concurrent overweight/obesity and anaemia within individuals.

In addition, separate tables summarising findings from included studies on the association between overweight/obesity and anaemia were created to complement part I of this review (i.e., magnitude and distribution of the DBM). These were kept separate and are presented in part II, as this evidence was not directly used to inform the research questions under investigation in this PhD. Nevertheless, key findings from part II are relevant and allow a better understanding of the relationship between both components of the DBM. Information populated from studies into the tables under this section encompassed: author (year), country, DBM level, method employed to quantify the association, population group studied, and key results. Main results from part II of this review were used to inform the discussion sections of the subsequent PhD chapters, as well as the overall discussion and future research directions.

2.4. Summary of findings (part I): magnitude and distribution of the double burden of overweight/obesity and anaemia

In total, 72 quantitative articles were included in this review, published between 2001 and 2021 (**Figure 2.1**). Main characteristics of studies are summarised in **Table 2.3**. Studies were cross-sectional in design, aiming to quantify the prevalence of overweight/obesity and anaemia at different levels in LMICs. Of the 72 articles, 14 were from the African region, 7 from the Eastern Mediterranean region, 3 from the European region, 26 from the Americas region, 12 from the Southeast Asian region, 7 from the Western Pacific region, and 3 encompassed countries located across different WHO regions. Studies spanned across 69 LMICs. Articles were written in English (n=72). Over half of studies included (39/72) were from the period 2017-2022, and only 10 articles were published before 2010.

The source of data varied across studies: 26 articles used primary data; whereas 43 were secondary data analyses, and three articles analysed data from the Obe-Maghreb project. The Demographic and Health Surveys (DHS) was the most repeated source of data (n=20). A total of 45 articles analysed data at the national level; while 27 covered a subgroup of a population (e.g., data collected at the school setting or from a particular region within a country).

The magnitude of the double burden of overweight/obesity and anaemia was estimated at the population (n=69), household (n=6) and individual (n=24) levels. Population groups at which the DBM was estimated were diverse, but mainly covered WRA and children under-5 (**Table 2.3**). At the population and/or individual levels, the DBM was quantified among: WRA (n=38), children under-5 (n=37), adolescents (n=15), school-age children (n=12), adults (both males and females; n=10), older adults (n=3) and children (age range falls under the category of school-age children and adolescents; n=4). At the household level, the magnitude of the DBM was quantified among mother-child dyads in the six studies included.

Additionally, there were 62 studies displaying stratified DBM estimates, 14 studies documenting trends, and 22 studies included prevalence data on specific micronutrient deficiencies in combination with overweight/obesity or alone (**Table 2.3**). Sociodemographic characteristics used by authors to explore the distribution of the DBM are presented in detail for each study in **Table 2.4**.

Table 2.3. Characteristics of studies identified in the literature on the magnitude of the double burden of overweight/obesity and anaemia in LMICs.

Author(s), year	**Country**	**Source of data**	**Level**	**Study population**	**DBM level**	**Stratified %**	**Trends**	**Micronutrients**
AFRICAN REGION (n=14)								
Jinabhai et al., 2001	South Africa	Cross-sectional survey	Subnational	SC (8-10y)	🌎	No	No	Vit A - iron
Ayogu et al., 2016	Nigeria	Cross-sectional survey	Subnational	ADO (12-18y)	🌎	Yes	No	Vit A - iron
Jones et al., 2016a	Multicountry (n=30)*	DHS	National	WRA	🌎 🚺	Yes	No	-
Teji et al., 2016	Ethiopia	Cross-sectional survey	Subnational	ADO girls	🌎	Yes	No	-
Anderson, 2017	Ghana	Cross-sectional survey	Subnational	Adults (18-100y)	🌎	Yes	No	-
Petry et al., 2019	Gambia	GMNS	National	WRA - PSC	🌎	Yes	No	Vit A - iron - iodine
Acharya et al., 2020	Multicountry (n=15)**	DHS	National	WRA	🚺	No	No	-
Amaha, 2020	Ethiopia	DHS	National	WRA - PSC	🌎	Yes	Yes	-
Ekholuenetale et al., 2020	Multicountry (n=35)***	DHS	National	PSC	🌎	Yes	No	-
Jiwani et al., 2020	Multicountry (n=35)***	DHS	National	WRA	🌎	Yes	Yes	-
Kushitor et al., 2020	Ghana	DHS	National	WRA	🌎 🚺	Yes	No	-
Rhodes et al., 2020	Malawi	MNS	National	WRA	🌎 🚺	Yes	No	Vit A - zinc - iron - folate B12
Wegmüller et al., 2020	Ghana	GMS	National	WRA - PSC (6-59mo)	🌎 🚺	Yes	No	Vit A - iron - folate - B12
Christian & Dake, 2021	Multicountry (n=23)****	DHS	National	WRA - PSC	🌎	No	No	-

DHS: Demographic and Health Surveys; GMNS: Gambia Micronutrient Survey; MNS: Malawi Micronutrient Survey; GMS: Ghana Micronutrient Survey; SC: school children; ADO: adolescents (10-19 years, unless otherwise stated); PSC: pre-school children (0-59 months, unless otherwise stated); WRA: women of reproductive age (15-49 years, unless otherwise stated).
DBM level: 🌎 Population level, 🏠 Household level, 🚺 Individual level
*LMICs included in Jones et al., 2016a: Benin, Burkina Faso, Cote d'Ivoire, Ghana, Guinea, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, DRC, Congo, Cameroon, Gabon, STP, Burundi, Ethiopia, Kenya, Rwanda, Tanzania, Uganda, Lesotho, Madagascar, Malawi, Mozambique, Namibia, Swaziland, Zambia and Zimbabwe.
**LMICs included in Acharya et al., 2020: DRC, Gabon, Zambia, Kenya, Rwanda, Benin, Cote d'Ivoire, Ghana, Guinea, Liberia, Mali, Nigeria, Senegal, Sierra Leone, Togo.
***LMICs included in Ekholuenetale et al., 2020 & Jiwani et al., 2020: Benin, Burkina Faso, Burundi, Cameroon, Chad, Congo, DRC, Cote d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia, Zimbabwe.
****LMICs included in Christian & Dake, 2021: Burkina Faso, Burundi, Cameroon, Congo, Benin, Ethiopia, Ghana, Guinea, Cote d'Ivoire, Kenya, Lesotho, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, South Africa, Zimbabwe, Tanzania, Zambia.

Table 2.3. (continued)

Author(s), year	Country	Source of data	Level	Study population	DBM level	Stratified %	Trends	Micronutrients
EASTERN MEDITERRANEAN REGION (n=7)								
Jildeh et al., 2011	Palestine	HBSC	Subnational	ADO (11-16y)	🌎	Yes	No	-
Fatima et al., 2014	Pakistan	Cross-sectional survey	Subnational	ADO girls (11-19y)	🌎	No	No	-
Gartner et al., 2014	Multicountry (n=2)*	Obe-Maghreb project	Subnational	WRA (20-49y)	🌎 🧍	No	No	Iron
Traissac et al., 2016	Tunisia	Obe-Maghreb project	Subnational	Adults (20-49y)	🌎 🧍	Yes	No	-
Sassi et al., 2019	Tunisia	Obe-Maghreb project	Subnational	WRA (20-49y) - PSC (6-59mo)	🌎 🏠	Yes	No	-
El-Shafie et al., 2020	Egypt	Cross-sectional survey	National	SC (6-11y)	🌎	Yes	No	-
Achouri et al., 2021	Morocco	Cross-sectional survey	Subnational	SC (6-12y)	🌎	Yes	No	-
EUROPEAN REGION (n=3)								
Rossi et al., 2005	Armenia	Cross-sectional survey	National	WRA (15-45y) - PSC (6-59mo)	🌎	Yes	No	-
Wirth et al., 2018	Azerbaijan	AzNS	National	WRA - PSC	🌎	Yes	No	Vit A - iron - zinc - folate - B12
Barth-Jaeggi et al., 2020	Tajikistan	Cross-sectional survey	National	WRA - PSC (5-59mo)	🌎	Yes	Yes	Vit A - iron - iodine - folate - D

HBSC: Health Behavior for School-Aged Children Project; AzNS: Azerbaijan Nutrition Survey; SC: school children; ADO: adolescents (10-19 years, unless otherwise stated); PSC: pre-school children (0-59 months, unless otherwise stated); WRA: women of reproductive age (15-49 years, unless otherwise stated).
DBM level: 🌎 Population level, 🏠 Household level, 🧍 Individual level
*LMICs included in Gartner et al., 2014: Morocco and Tunisia.

Table 2.3. (continued)

Author(s), year	Country	Source of data	Level	Study population	DBM level	Stratified %	Trends	Micronutrients
				AMERICAS REGION (n=29)				
Rivera & Sepúlveda, 2003	Mexico	NNS	National	WRA (12-49y) - PSC - SC (5-11y)	Population	Yes	Yes	Vit A - iron - zinc - folate - C
Monárrez-Espino et al., 2004	Mexico	Cross-sectional survey	Subnational	SC (6-14y)	Population	Yes	No	Iron - zinc - folic acid - B12
Gross et al., 2006	Peru	Cross-sectional survey	Subnational	PSC & parents	Population	Yes	No	-
Orellana et al., 2006	Brazil	Cross-sectional survey	Subnational	Children (0-10y)	Population	Yes	No	-
Rivera et al., 2009	Mexico	ENN & ENSANUT	National	PSC - SC (5-11y) - ADO (12-18y) - adults (20-59y) - older adults (>60y)	Population	Yes	Yes	-
Novaes-Oliveira et al., 2010	Brazil	Cross-sectional survey	Subnational	PSC (4-29mo)	Population, Individual	No	No	-
Leite et al., 2013	Brazil	Cross-sectional survey	Subnational	PSC (12-60mo)	Population	No	No	-
Atalah et al., 2014	Chile	Multiple (n=5)*	National	PSC - WRA (15-64y) - older adults (>65y)	Population	Yes	No	Vit A - B12 - C - calcium - zinc
Conde & Monteiro, 2014	Brazil	Multiple (n=6)**	National	PSC - SC(5-19y) - adults (>20y)	Population, Individual	Yes	Yes	-
Freire et al., 2014	Ecuador	ENSANUT-ECU	National	PSC - SC (5-11y) - WRA (12-49y)	Population, Household, Individual	Yes	No	Zinc
Kroker-Lobos et al., 2014	Mexico	National Health and Nutrition Surveys	National	PSC - SC (5-11y) - WRA (20-49y)	Population, Individual	Yes	Yes	-
Loret-de-Mola et al., 2014	Peru	DHS	National	WRA - PSC	Population	Yes	Yes	-
Ramirez-Zea et al., 2014	Guatemala	ENSMI	National	WRA - PSC	Population, Individual	Yes	Yes	-

NNS: Mexican National Nutrition Survey; ENN: Encuesta Nacional de Nutrición y Salud; ENSANUT: National Survey of Health and Nutrition; ENSANUT-ECU: Ecuadorian National Health and Nutrition Survey; DHS: Demographic and Health Surveys; SC: school children; ADO: adolescents (10-19 years, unless otherwise stated); PSC: pre-school children (0-59 months, unless otherwise stated); WRA: women of reproductive age (15-49 years, unless otherwise stated).
DBM level: Population level, Household level, Individual level
*Data sources for Atalah et al., 2014 include: data collected by the Health Ministry, the Education ministry, the 2003 and 2009-2010 National Health Surveys, the 2010-2011 National Food Consumption Survey (ENCA), and a Food Insecurity Survey.
**Data sources for Conde & Monteiro, 2014 include: DHS, the National Study on Family Expenditures, the National Health and Nutrition Survey, and Family Budget Surveys.

Table 2.3. (continued)

Author(s), year	Country	Source of data	Level	Study population	DBM level	Stratified %	Trends	Micronutrients
				AMERICAS REGION (n=29)				
Sarmiento et al., 2014	Colombia	DHS, ENDS & ENSIN	National	PSC - SC (5-11y) - ADO (12-19y) - adults (18-64y)	🌎 🚹	Yes	No	-
Jardim-Botelho et al., 2016	Brazil	Cross-sectional survey	Subnational	PSC (2-11mo)	🌎	No	No	Zinc - copper - selenium - iron
Jones et al., 2017	Mexico	ENSANUT	National	ADO girls (15-19y) - WRA (20-40y)	🌎 🚹	No	No	-
Jones et al., 2018	Bolivia	Cross-sectional survey	Subnational	WRA - PSC (6-59mo)	🌎 🏠 🚹	Yes	No	-
Terán et al., 2018	Bolivia	Cross-sectional survey	Subnational	SC (6-12y)	🌎	Yes	No	Zinc - Vit D
Batis et al., 2020a	Mexico	ENSANUT	National	PSC - ADO girls (11-19y) - WRA (20-49y)	🌎	Yes	No	-
Cediel et al., 2020	Colombia	ENDS & ENSIN	National	PSC - ADO girls (11-19y) - WRA (20-49y)	🌎	Yes	No	-
Curi-Quinto et al., 2020	Peru	ENDES	National	WRA - PSC	🌎	Yes	No	-
Miranda et al., 2020	Bolivia	DHS	National	PSC - ADO girls (15-19y) - WRA (20-49y)	🌎	Yes	No	-
Mujica-Coopman et al., 2020	Chile	ENS	National	Adults (20-49y) - older adults (>49y)	🌎	Yes	No	-
Ramírez-Luzuriaga et al., 2020	Ecuador	ENSANUT-ECU	National	PSC - ADO girls (11-19y) - WRA (20-49y)	🌎	Yes	No	-
Zapata et al., 2020	Argentina	ENNyS	National	PSC - ADO girls (11-19y) - WRA (20-49y)	🌎	Yes	No	-
Tallman et al., 2022	Peru	Cross-sectional survey	Subnational	Adults	🌎	Yes	Yes	-

ENSMI: Encuesta Nacional de Salud Materno Infantil; DHS: Demographic and Health Surveys; ENDS: Encuesta Nacional de Demografía y Salud; ENSIN: Encuesta Nacional de la Situación Nutricional en Colombia; ENSANUT: National Survey of Health and Nutrition; ENDS: Encuesta Nacional de Demografía y Salud; ENDES: Peruvian National Demographic and Family Health Survey; ENS: Nationally representative survey; ENSANUT-ECU: Ecuadorian National Health and Nutrition Survey; ENNyS: National Health and Nutrition Survey; SC: school children; ADO: adolescents(10-19 years, unless otherwise stated); PSC: pre-school children(0-59 months, unless otherwise stated); WRA: women of reproductive age(15-49 years, unless otherwise stated).
DBM level: 🌎 Population level, 🏠 Household level, 🚹 Individual level

Table 2.3. (continued)

Author(s), year	Country	Source of data	Level	Study population	DBM level	Stratified %	Trends	Micronutrients
				SOUTEAST ASIAN REGION (n=12)				
Jayatissa & Ranbanda, 2006	Sri Lanka	Cross-sectional survey	National	ADO (10-15y)	Population	Yes	No	Vit A
Rojroongwasinkul et al., 2013	Thailand	SEANUTS	National	Children (0.5-13y)	Population	Yes	No	Vit A - D - iron
Sandjaja et al., 2013	Indonesia	SEANUTS	National	Children (0.5-12y)	Population	Yes	No	Vit D - iron
Naotunna et al., 2017	Sri Lanka	Cross-sectional survey	Subnational	SC (5-10y)	Population	Yes	No	-
Lee & Ryu, 2018	Indonesia	Cross-sectional survey	Subnational	Adults (19->65y)	Population, Individual	Yes	No	-
Bharati et al., 2019	India	NFHS-4	National	WRA	Population	Yes	No	-
Mamun & Mascie-Taylor, 2019	Bangladesh	DHS	National	WRA - PSC	Household	Yes	No	-
India State-Level Disease Burden Initiative Malnutrition Collaborators, 2019	India	Multiple sources	National	WRA - PSC	Population	Yes	Yes	-
Varghese & Stein, 2019	India	NFHS-4	National	WRA – PSC (6-59mo)	Population, Household, Individual	Yes	No	-
Little et al., 2020	India	Cross-sectional survey	Subnational	Adults (20-92y)	Individual	Yes	No	-
Sethi et al., 2020	India	DHS	Subnational	WRA (20-49y)	Population, Individual	Yes	Yes	-
Kumar et al., 2021	India	NFHS-4	National	WRA - PSC	Population, Household	No	No	-

SEANUTS: South East Asian Nutrition Survey; NFHS: National Family Health Survey (available from the DHS programme website); DHS: Demographic and Health Surveys; SC: school children; ADO: adolescents (10-19 years, unless otherwise stated); PSC: pre-school children (0-59 months, unless otherwise stated); WRA: women of reproductive age (15-49 years, unless otherwise stated).
DBM level: Population level, Household level, Individual level

Table 2.3. (continued)

Author(s), year	Country	Source of data	Level	Study population	DBM level	Stratified %	Trends	Micronutrients
				WESTERN PACIFIC REGION (n=7)				
Shi et al., 2005	China	Cross-sectional survey	Subnational	ADO (12-14y)	🌎	Yes	No	-
Laillou et al., 2014	Vietnam	Cross-sectional survey	National	WRA	🌎 🚹	Yes	No	Iron - B12 - zinc - folate
Greffeuille et al., 2016a	Cambodia	DHS	National	PSC	🌎	Yes	Yes	-
Greffeuille et al., 2016b	Cambodia	DHS	National	WRA	🌎	Yes	Yes	-
Zou et al., 2016	China	Chinese National Nutrition Survey	Subnational	Children (7-12y) - ADO (13-17y)	🌎 🚹	Yes	No	-
Choy et al., 2017	Samoa	Cross-sectional survey	Subnational	PSC (24-59mo)	🌎 🚹	Yes	No	-
Chuc et al., 2019	Vietnam	Cross-sectional survey	Subnational	PSC (12-36mo)	🌎	Yes	No	Vit D
				MULTIREGIONAL (n=3)				
Eckhardt et al., 2008	Multicountry (n=3)*	NNS & DHS	National	WRA (18-49y)	🌎	Yes	No	-
Engle-Stone et al., 2020	Multicountry (n=20)**	BRINDA	National	PSC	🌎 🚹	Yes	No†	Vit A - iron - zinc - B12 - D - folate
Williams et al., 2020	Multicountry (n=14)***	BRINDA	National	WRA	🌎 🚹	Yes	No†	Vit A - iron - zinc - B12 - D - folate

DHS: Demographic and Health Surveys; NNS: Mexican National Nutrition Survey; BRINDA: Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia project; SC: school children; ADO: adolescents (10-19 years, unless otherwise stated); PSC: pre-school children (0-59 months, unless otherwise stated); WRA: women of reproductive age (15-49 years, unless otherwise stated).
DBM level: 🌎 Population level, 🏠 Household level, 🚹 Individual level
*LMICs included in Eckhardt et al., 2008: Mexico, Peru and Egypt.
**LMICs included in Engle-Stone et al., 2020: Bangladesh, Cambodia, Laos, Mongolia, Papua New Guinea, Philippines, Vietnam, Cote d' Ivoire, Cameroon, Kenya, Liberia, Malawi, Colombia, Ecuador, Mexico, Nicaragua, Afghanistan, Azerbaijan, Georgia and Pakistan.
***LMICs included in Williams et al., 2020: Mexico, Ecuador, Colombia, Azerbaijan, Georgia, Afghanistan, Pakistan, Cameroon, Cote d' Ivoire, Malawi, Papua New Guinea, Cambodia, Laos and Vietnam.
† Although trends are not investigated in the two studies, they present prevalence estimates at two different data points for Kenya and Bangladesh in Engle-Stone et al., 2020 and for Mexico in Williams et al., 2020.

Table 2.4. Sociodemographic and other characteristics employed in studies to explore the distribution of the double burden of overweight/obesity and anaemia among population subgroups.

	Equity stratifiers								
Author(s), year	**Residence**	**Ethnicity**	**Occupation**	**Gender**	**Religion**	**Education**	**SES**	**Social capital**	**Other**
AFRICAN REGION									
Jinabhai et al., 2001	X	X	X	X	X	X	X	X	X
Ayogu et al., 2016	X	X	X	X	X	X	A	A	Y
Jones et al., 2016a	Y	X	X	X	X	A	A	X	Y
Teji et al., 2016	A	X	A	X	X	X	X	A	Y
Anderson, 2017	X	X	X	Y	X	X	X	X	Y
Petry et al., 2019	Y	X	X	Y	X	Y	Y	X	Y
Acharya et al., 2020	A	X	X	X	X	A	A	A	A
Amaha, 2020	X	X	X	X	X	X	X	X	Y
Ekholuenetale et al., 2020	Y	X	X	X	X	Y	Y	X	Y
Jiwani et al., 2020	Y	X	X	X	X	Y	Y	X	Y
Kushitor et al., 2020*	Y	Y	X	X	X	Y	Y	Y	Y
Rhodes et al., 2020	Y	X	X	X	X	X	X	X	X
Wegmüller et al., 2020	Y	X	X	X	X	X	Y	X	Y
Christian & Dake, 2021**	A	X	X	X	X	A	A	A	A
EASTERN MEDITERRANEAN REGION									
Jildeh et al., 2011	X	X	X	Y	X	X	X	X	Y
Fatima et al., 2014	X	X	X	X	X	X	X	X	A
Gartner et al., 2014	A	X	A	X	X	A	A	A	A
Traissac et al., 2016	Y	X	Y	Y	X	Y	Y	Y	Y
Sassi et al., 2019	X	X	Y	Y	X	Y	Y	Y	Y
El-Shafie et al., 2020	Y	X	X	Y	X	X	Y	X	Y
Achouri et al., 2021	X	X	X	Y	X	X	X	X	Y
EUROPEAN REGION									
Rossi et al., 2005	Y	X	X	X	X	X	X	X	Y
Wirth et al., 2018	Y	X	X	Y	X	Y	Y	Y	Y
Barth-Jaeggi et al., 2020	Y	X	X	X	X	X	X	X	Y
AMERICAS REGION									
Rivera & Sepúlveda, 2003	Y	Y	X	X	X	X	Y	X	Y
Monárrez-Espino et al., 2004	X	X	X	Y	X	X	X	X	Y
Gross et al., 2006	X	X	X	X	X	X	Y	X	Y
Orellana et al., 2006	X	X	X	Y	X	X	X	X	Y
Rivera et al., 2009	Y	Y	X	Y	X	X	Y	X	Y
Novaes-Oliveira et al., 2010	X	X	X	X	X	X	A	A	A

Y: Yes, present; X: No, not present; A: additional variable used for association, but not in stratified analyses.
*Stratified prevalences are presented for the DBM, defined as underweight or overweight/obesity and anaemia.
**Authors use different DBM definitions than those employed throughout this thesis.

Table 2.4. (continued)

Author(s), year	Equity stratifiers								
	Residence	Ethnicity	Occupation	Gender	Religion	Education	SES	Social capital	Other
AMERICAS REGION									
Leite et al., 2013	X	X	X	X	X	X	X	X	X
Atalah et al., 2014	X	X	X	X	X	X	X	X	Y
Conde & Monteiro, 2014	X	X	X	Y	X	X	Y	X	Y
Freire et al., 2014	X	Y	X	Y	X	X	X	X	Y
Kroker-Lobos et al., 2014	X	X	X	Y	X	X	X	X	Y
Loret-de-Mola et al., 2014	Y	X	X	X	X	X	X	X	Y
Ramirez-Zea et al., 2014	X	Y	X	X	X	X	X	X	Y
Sarmiento et al., 2014	X	X	X	Y	X	X	Y	X	Y
Jardim-Botelho et al., 2016	X	X	X	X	X	X	X	X	X
Jones et al., 2017	A	X	X	X	X	A	A	A	A
Jones et al., 2018	Y	X	X	A	X	A	A	A	A
Terán et al., 2018	X	X	X	Y	X	X	X	X	Y
Batis et al., 2020a	Y	Y	X	X	X	Y	Y	X	X
Cediel et al., 2020	X	Y	X	X	X	Y	Y	X	X
Curi-Quinto et al., 2020	X	Y	X	X	X	Y	Y	X	X
Miranda et al., 2020	X	Y	X	X	X	Y	Y	X	X
Mujica-Coopman et al., 2020	X	Y	X	X	X	Y	Y	X	X
Ramírez-Luzuriaga et al., 2020	X	Y	X	X	X	Y	Y	X	X
Zapata et al., 2020	X	X	X	X	X	Y	Y	X	X
Tallman et al., 2022	X	X	X	Y	X	X	X	X	X
SOUTHEAST ASIAN REGION									
Jayatissa & Ranbanda, 2006	Y	X	X	Y	X	X	X	X	Y
Rojroongwasinkul et al., 2013	Y	X	X	X	X	X	X	X	Y
Sandjaja et al., 2013	Y	X	X	Y	X	X	X	X	Y
Naotunna et al., 2017	X	X	X	Y	X	X	X	X	Y
Lee & Ryu, 2018	X	A	X	Y	X	X	X	X	A
Bharati et al., 2019	Y	X	X	X	Y	Y	Y	X	Y
Mamun & Mascie-Taylor, 2019	Y	X	Y	X	X	Y	Y	Y	Y
India State-Level Disease Burden Initiative Malnutrition Collaborators, 2019	X	X	X	X	X	X	Y	X	Y
Varghese & Stein, 2019	X	X	X	X	X	X	A	X	Y
Little et al., 2020	A	A	A	Y	A	X	A	A	A
Sethi et al., 2020	X	A	A	X	A	A	Y	A	A
Kumar et al., 2021***	A	A	X	A	A	A	A	X	A

Y: Yes, present; X: No, not present; A: additional variable used for association, but not in stratified analyses.
***Associations are conducted using a different DBM definition: overweight/obese mother and undernourished child (stunting/wasting/underweight) who was also anaemic.

Table 2.4. (continued)

Author(s), year	Equity stratifiers								
	Residence	Ethnicity	Occupation	Gender	Religion	Education	SES	Social capital	Other
WESTERN PACIFIC REGION									
Shi et al., 2005	Y	X	X	X	X	Y	Y	Y	Y
Laillou et al., 2014	Y	Y	X	X	X	Y	Y	X	Y
Greffeuille et al., 2016a	Y	X	X	Y	X	Y	Y	X	Y
Greffeuille et al., 2016b	Y	X	X	X	X	Y	Y	X	Y
Zou et al., 2016	Y	X	X	Y	X	X	X	X	Y
Choy et al., 2017	X	X	X	Y	X	Y	Y	Y	Y
Chuc et al., 2019	X	X	X	Y	X	X	X	X	Y
MULTIREGIONAL									
Eckhardt et al., 2008	Y	X	X	X	X	Y	Y	Y	Y
Engle-Stone et al., 2020	A	X	X	A	X	A	A	X	Y
Williams et al., 2020	A	X	X	X	X	A	A	X	Y

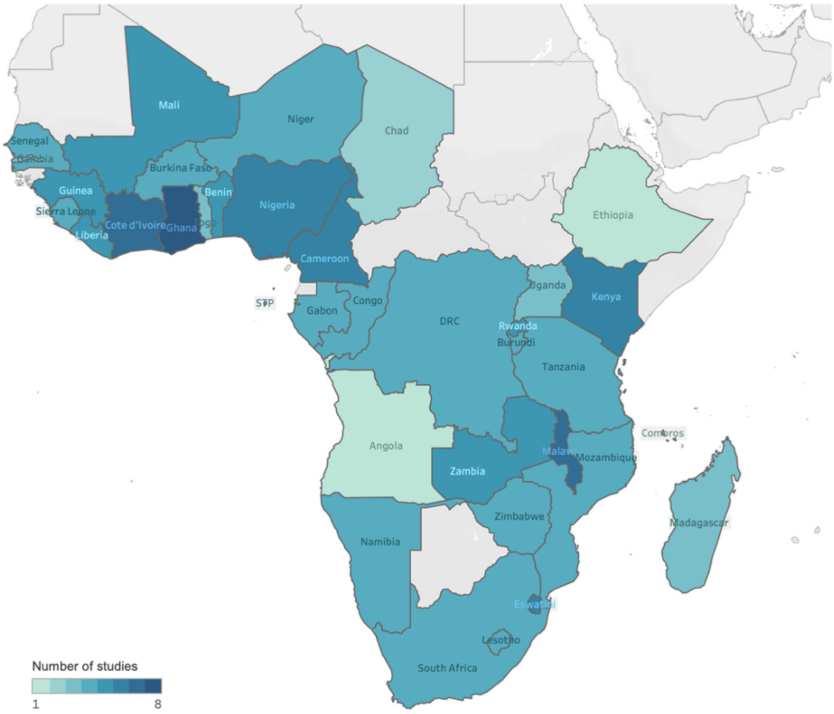
Y: Yes, present; X: No, not present; A: additional variable used for association, but not in stratified analyses.

2.4.1. African region

The search yielded 16 records that included countries (n=36) within the African region, published between 2001 and 2021 (**Figure 2.2**). Most evidence came from Ghana (n=8), followed by Malawi and Cote d'Ivoire, both present in seven studies. Of the 16 studies, seven were multicountry (Jones et al., 2016a; Acharya et al., 2020; Ekholuenetale et al., 2020; Jiwani et al., 2020; Engle-Stone et al., 2020; Williams et al., 2020; Christian & Dake, 2021). Among studies of secondary data, the main sources utilised comprised: DHS (n=7) and National Micronutrient Surveys of Gambia, Malawi and Ghana (n=3). Additionally, two studies used data from the Biomarkers Reflecting Inflammation and Nutrition Determinants of Anemia (BRINDA) project (https://brinda-nutrition.org), which goal is to improve micronutrient assessment and anaemia characterisation and includes 31 datasets at the national and subnational level across the globe (Engle-Stone et al., 2020; Williams et al., 2020). Four studies analysed primary data collected at the subnational level in schools (Jinabhai et al., 2001; Ayogu et al., 2016) or communities (Teji et al., 2016; Anderson, 2017).

In the identified studies, the DBM was measured at the population (n=16) and individual (n=7) levels (**Table 2.3**). No studies were found investigating the magnitude of the DBM at the household level, defined as maternal overweight/obesity and childhood anaemia or childhood overweight/obesity and maternal anaemia within the same household. The DBM was quantified among WRA (n=10), children under-5 (n=6), school-age children (n=1) and adolescents (n=2). One study included adults aged 18 to 100 years old (Anderson, 2017).

Figure 2.2. Map displaying countries within the African region included in the review.



Stratified prevalence estimates were calculated in 13 studies by one or more sociodemographic characteristics (**Table 2.4**). At the population level, childhood anaemia was more prevalent in rural areas (Petry et al., 2019; Ekholuenetale et al., 2020; Wegmüller et al., 2020), lower household wealth groups (Ekholuenetale et al., 2020; Wegmüller et al., 2020) and lower maternal education levels (Ekholuenetale et al., 2020); while overweight/obesity among children under-5 was more prevalent in urban or capital cities (Amaha, 2020; Ekholuenetale et al., 2020), higher household wealth groups (Ekholuenetale et al., 2020) and lower maternal education levels (Ekholuenetale et al., 2020). The prevalence of childhood overweight/obesity was 0.0% in one study (Petry et al., 2019). Another study found that sex, residence, household wealth, maternal education and age did not consistently predict overweight/obesity or anaemia; although in 5/6 of African surveys included, younger age (< 24 months) was associated with lower odds of anaemia (Engle-Stone et al., 2020). Among WRA, the prevalence of overweight/obesity was higher among urban areas (Jones et al., 2016a; Petry et al., 2016 (for overweight only); Jiwani et al., 2020; Rhodes et al., 2020; Wegmüller et al., 2020), peri-urban areas (Jones et al., 2016a), capital cities (Jiwani et al., 2020), highest household wealth groups (Jiwani et al., 2020; Wegmüller et al., 2020; Williams et al., 2020), adult women or older age (Jiwani et al., 2020; Wegmüller et al., 2020; Williams et al., 2020) and highest education levels (Jiwani et al., 2020 (although not marked inequalities)); whereas the burden of anaemia was higher among rural areas (Jones et al., 2016a; Amaha et al., 2020) and lowest household wealth groups (Jiwani et al., 2020). Some studies showed no significant differences in anaemia prevalence by area of residence (Jones et al., 2016a; Jiwani et al., 2020 (pregnant women); Rhodes et al., 2020; Wegmüller et al., 2020; Williams et al., 2020) or household wealth groups (Williams et al., 2020).

At the individual level, the co-occurrence of overweight/obesity and anaemia among WRA was higher in urban areas (Jones et al., 2016a; Acharya et al., 2020; Kushitor et al., 2020), West and Central Africa (Jones et al., 2016a), primary education level (Acharya et al., 2020), higher education levels (Kushitor et al., 2020), higher household wealth groups (Acharya et al., 2020; Williams et al., 2020 (only in Cameroon and Malawi);), older age (Acharya et al., 2020; Kushitor et al., 2020; Williams et al., 2020 (only in Cote d'Ivoire and Malawi)), access to improved water and sanitation (Acharya et al., 2020) and being married (Kushitor et al., 2020). In a few studies, the co-occurrence of overweight/obesity and anaemia among WRA did not significantly differ by area of residence (Rhodes et al., 2020; Williams et al., 2020) or by education levels (Williams et al., 2020); although the prevalence was higher in urban than rural areas (Rhodes et al., 2020). Likewise, DBM at the individual level among WRA was not associated with forest cover loss (Acharya et al., 2020). Among children under-5, the co-occurrence of overweight/obesity and anaemia was lower in those 24 months or older in Cote d'Ivoire and Malawi, but higher in Liberia; DBM was higher in lower household wealth groups in Kenya and higher maternal education levels in Malawi (Engle-Stone, 2020). There were no significant associations found between other sociodemographic characteristics (e.g., area of residence) and the co-occurrence of overweight/obesity and anaemia among children under-5 (Engle-Stone, 2020).

Only two studies, one in Ethiopia and one multi-country, reported trends in the DBM at the population level. Overall, overweight/obesity is increasing rapidly in the region, particularly among adult women (20-49 years), women with no education and capital city residents; while anaemia declined, particularly among adult women and pregnant women in the higher household wealth groups, but remains an important burden among WRA with no marked disparities (Jiwani et al., 2020). In Ethiopia, the prevalence of overweight/obesity increased in most regions, with Addis Ababa presenting the highest prevalence; while anaemia among WRA increased across all regions (Amaha, 2020).

In terms of micronutrient deficiencies, seven articles included iron and vitamin A prevalence data across different African countries; while iodine, zinc, folate and vitamin B12 were present in one, three, four and four studies, respectively.

2.4.2. Eastern Mediterranean region

Ten studies, published between 2008 and 2021, were based in countries located within the Eastern Mediterranean region including: Afghanistan (n=2), Egypt (n=2), Morocco (n=2), Pakistan (n=3), Palestine (n=1) and Tunisia (n=3) (**Figure 2.3**). Of the ten studies, four were multicountry (Eckhardt et al., 2008; Gartner et al., 2014; Engle-Stone et al., 2020; Williams et al., 2020), and three were in the category multiregional (Eckhardt et al., 2008; Engle-Stone et al., 2020; Williams et al., 2020). Six articles were primary research and four were secondary research. Data sources utilised in studies conducting secondary analysis involved: Health Behaviour for School-Aged Children Project (HBSC; n=1), DHS (n=1) and data from the BRINDA project (n=2). Three studies used primary data from the Obe-Maghreb project (https://clinicaltrials.gov/ct2/show/NCT01844349) (Gartner et al., 2014; Traissac et al., 2016; Sassi et al., 2019). A specific objective of this project was to characterise the nature and size of the double burden (obesity/undernutrition) in regions, families and individuals living in the Maghreb region (North Africa).

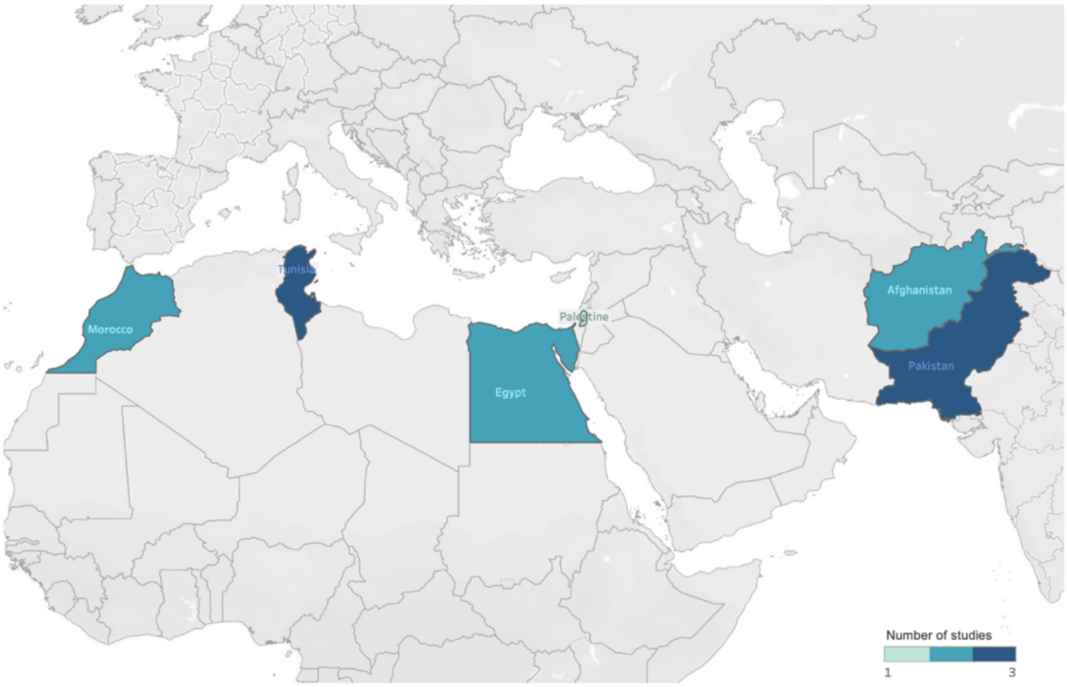
In the included studies, the DBM was measured at the population (n=10), household (n=1) and individual (n=4) levels (**Table 2.3**). The DBM was quantified among WRA (n=4), children under-5 (n=2), school-age children (n=2) and adolescents (n=2). One study included adults (males and females) aged 20-49 years old (Traissac et al., 2016). At the household level, the DBM was quantified in mother-child dyads, restricted to WRA (20-49 years old) and children under-5 (6-59 months) (Sassi et al., 2019).

Stratified prevalence estimates were calculated in eight studies by one or more sociodemographic characteristics (**Table 2.4**). At the population level, children were more likely to be anaemic with younger age in Pakistan but not Afghanistan, and lower household wealth groups and urban areas of Pakistan; while childhood overweight/obesity was more prevalent in those younger than 24 months and higher household wealth groups of Pakistan (Engle-Stone et al., 2020). Among WRA, overweight/obesity increased with age in Tunisia, Morocco and Pakistan (Gartner et al., 2014; Williams et al., 2020), parity in Morocco (Gartner et al., 2014), household wealth in Morocco, Afghanistan and Pakistan (Gartner et al., 2014 (not statistically significant results for Tunisia); Williams et al., 2020), married status in Tunisia (Gartner et al., 2014), and urban residency and education level in Pakistan (Williams et al., 2020); while anaemia was more prevalent in the lower household wealth groups in Tunisia and Pakistan (Gartner et al., 2014; Williams et al., 2020) and urban areas of Pakistan (Williams et al., 2020). One study in Egypt exploring the magnitude of DBM at the population level among school-aged children (6-12 years) reported significant differences by sociodemographic factors as follows: anaemia was more common among girls, younger age (<9 years old), rural areas and lower household wealth groups; while overweight/obesity was more prevalent among girls, older age, urban areas and higher household wealth groups (El-Shafie et al., 2020). Another study conducted among adolescents (11-16 years old) in East Jerusalem found no statistically significant differences by sex in the prevalence of overweight, obesity or anaemia, but higher estimates among girls (Jildeh et al., 2011). Likewise, sex differences in the prevalence of both forms of malnutrition was also reported among adults (20-49 years old) in Tunisia, where the burden of overweight/obesity and anaemia was concentrated among women (Traissac et al., 2016).

At the household level, evidence from urban Tunisia showed that maternal overweight/obesity and childhood anaemia was more common among child-mother dyads with younger children, older mothers (>30 years old), higher parity and higher maternal energy intakes (Sassi et al., 2019). The study also reported higher estimates of maternal overweight/obesity and childhood anaemia among lower household wealth groups, but this was not statistically significant (Sassi et al., 2019).

At the individual level, the co-occurrence of overweight/obesity and anaemia among WRA was higher in urban areas of Pakistan but not Afghanistan (Williams et al., 2020), higher household wealth groups in Pakistan and Morocco (Williams et al., 2020; Gartner et al., 2014), higher education levels and older women in Pakistan (Williams et al., 2020) and married women in Tunisia (Gartner et al., 2014). A study investigating sex differences in the co-occurrence of overweight/obesity and anaemia among adults (20-49 years) in Tunisia, also found important gender inequalities in DBM magnitude (overall %: 13.6%; women: 24.1%; men: 3.4%), higher than for the bivariate prevalence of overweight or anaemia (Traissac et al., 2016). Among children under-5, the co-occurrence of overweight/obesity and anaemia was less prevalent in those aged 24 months or older in Pakistan, and those in the higher household wealth groups and males in Afghanistan (Engle-Stone et al., 2020). Urban or rural location were not found to be associated with DBM at the individual level among children under-5 living in countries within the Eastern Mediterranean region (Engle-Stone et al., 2020).

Figure 2.3. Map displaying countries within the Eastern Mediterranean region included in the review.

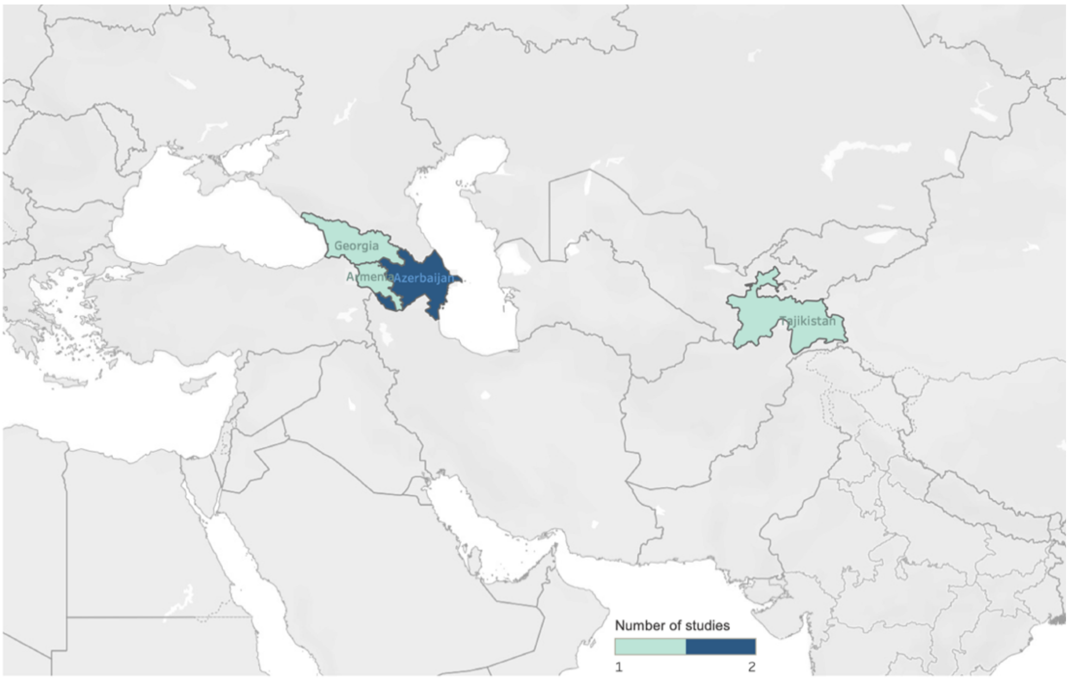


Studies included did not report trends in the double burden of overweight/obesity and anaemia at the population, household or individual levels. Micronutrient deficiencies were present in three studies for iron; while the prevalence of vitamin A, zinc and vitamin D was calculated in two studies, and that of folate and vitamin B12 in one.

2.4.3. European region

Five studies, published between 2005 and 2020, reported DBM estimates in countries located within the European region. European LMICs represented in these studies comprised: Armenia (n=1), Azerbaijan (n=2), Georgia (n=1), Tajikistan (n=1) (**Figure 2.4**). Two studies were multicountry and multiregional (Engle-Stone et al., 2020; Williams et al., 2020). Of the five studies, two were primary research and three were secondary analyses of data. Sources of data for the latter included: the Azerbaijan Nutrition Survey (AzNS; n=1) and data from the BRINDA project (n=2). All studies included were classified as being nationally representative.

Figure 2.4. Map displaying countries within the European region included in the review.



The DBM magnitude was quantified at the population (n=5) and individual (n=2) levels (**Table 2.3**). Of the studies retrieved from the search, none investigated the magnitude of the DBM at the household level. The DBM was measured among WRA (n=4) and children under-5 (n=4).

Stratified prevalence estimates were calculated in all five studies by one or more sociodemographic characteristics (**Table 2.4**). At the population level, childhood anaemia was more prevalent among rural residents in Armenia and Tajikistan (Rossi et al., 2005; Barth-Jaeggi et al., 2020), younger children in Azerbaijan and Georgia (Wirth et al., 2018; Engle-Stone et al., 2020) and males in Azerbaijan (Wirth et al., 2018; Engle-Stone et al., 2020); while childhood overweight/obesity was higher in urban areas and residents when compared to refugees in Armenia (Rossi et al., 2005), younger children in Azerbaijan and Georgia (Engle-Stone et al., 2020) and males in Azerbaijan (Engle-Stone et al., 2020). Among WRA, overweight/obesity was more prevalent in certain regions of Armenia and Tajikistan (Rossi et al., 2005; Barth-Jaeggi et al., 2020), urban areas of Tajikistan, Azerbaijan and Georgia (Barth-Jaeggi et al., 2020; Williams et al., 2020), higher household wealth groups in Azerbaijan (Williams et al., 2020) and older women in Azerbaijan and Georgia (Williams et al., 2020); while the burden of anaemia was higher in rural areas of Armenia and Tajikistan (Rossi et al., 2005; Barth-Jaeggi et al., 2020), urban areas and certain regions of Azerbaijan (Wirth et al., 2018), younger age in Azerbaijan (Wirth et al., 2018; Williams et al., 2020) and older women in Tajikistan (Barth-Jaeggi et al., 2020). Food intake differences in women living with anaemia versus those without anaemia, were also identified in Tajikistan (Barth-Jaeggi et al., 2020).

At the individual level, the co-occurrence of overweight/obesity and anaemia among WRA was only associated with older age in Georgia (Williams et al., 2020). Among children under-5, the co-occurrence of overweight/obesity and anaemia was associated with younger age in Azerbaijan and Georgia and lower household wealth groups in Azerbaijan only (Engle-Stone et al., 2020).

Trends in the magnitude of overweight/obesity were documented in one study at the population level (Barth-Jaeggi et al., 2020). In Tajikistan, the national prevalence of overweight/obesity among WRA increased steadily from 2003 to 2017 (Barth-Jaeggi et al., 2020).

In terms of micronutrient deficiencies, four studies presented prevalence data on micronutrients: iron (n=4), vitamin A (n=4), zinc (n=2), iodine (n=1), folate (n=3), vitamin B12 (n=3) and vitamin D (n=1).

2.4.4. Americas region

The search yielded a total of 29 articles published between 2003 and 2022. Studies were based in ten different countries: Argentina (n=1), Bolivia (n=3), Brazil (n=5), Chile (n=2), Colombia (n=4), Ecuador (n=4), Guatemala (n=1), Mexico (n=9), Nicaragua (n=1) and Peru (n=7) (**Figure 2.5**). Three studies were multicountry and multiregional (Eckhardt et al., 2008; Engle-Stone et al., 2020; Williams et al., 2020). More than half of studies (n=20) were secondary data analyses of different national health and nutrition surveys (**Table 2.3**).

In the included studies, the DBM was measured at the population (n=29), household (n=2) and individual (n=10) levels (**Table 2.3**). The DBM was quantified among WRA (n=16), children under-5 (n=21), school-age children (n=8) and adolescents (n=8). Other age groups included in the studies were: parents (age range not specified; n=1), children (n=1), adults (both males and females; n=5), and older adults (n=3). At the household level, the DBM was quantified in mother-child dyads, restricted to mothers and children under-5 (6-59 months) (Freire et al., 2014; Jones et al., 2018).

Stratified prevalence estimates were calculated in 25 studies by one or more sociodemographic characteristics (**Table 2.4**). At the population level, childhood anaemia was higher among younger children in Colombia, Ecuador, Mexico, Nicaragua and Brazil (Novaes-Oliveira et al., 2010; Engle-Stone et al., 2020), lower household wealth groups in Mexico, Ecuador, Colombia, Peru, Bolivia and Argentina (Batis et al., 2020a; Cediel et al., 2020; Curi-Quinto et al., 2020; Engle-Stone et al., 2020; Miranda et al., 2020; Ramirez-Luzuriaga et al., 2020; Zapata et al., 2020), lower maternal education levels in Nicaragua, Mexico, Peru, Bolivia, Ecuador and Argentina (Batis et al., 2020a; Curi-Quinto et al., 2020; Engle-Stone et al., 2020; Miranda et al., 2020; Ramirez-Luzuriaga et al., 2020; Zapata et al., 2020), urban areas in Ecuador (Engle-Stone et al., 2020), rural areas in Peru and Bolivia (Loret-de-Mola et al., 2014; Jones et al., 2018) and indigenous children in Mexico, Colombia, Peru, Bolivia and Ecuador (Rivera & Sepúlveda, 2003; Cediel et al., 2020; Curi-Quinto et al., 2020; Miranda et al., 2020; Ramirez-Luzuriaga et al., 2020); while childhood overweight/obesity was more prevalent among younger children in Colombia and Mexico (Engle-Stone et al., 2020), males in Mexico, Nicaragua and Colombia (Sarmiento et al., 2014; Engle-Stone et al., 2020), urban areas and certain regions of Mexico (Rivera & Sepúlveda, 2003; Batis et al., 2020a), higher household wealth groups in Colombia, Mexico, Peru and Argentina (Sarmiento et al., 2014; Batis et al., 2020a (obesity only); Cediel et al., 2020; Curi-Quinto et al., 2020; Zapata et al., 2020), peri-urban areas (but not urban areas) of Bolivia (Jones et al., 2018), higher maternal education levels in Colombia, Peru and Argentina (Cediel et al., 2020; Curi-Quinto et al., 2020; Zapata et al., 2020), indigenous children in Colombia (Cediel et al., 2020) and non-indigenous children in Peru (Curi-Quinto et al., 2020). Among WRA, the burden of overweight/obesity was concentrated in urban areas of Mexico and Peru (Eckhardt et al., 2008; Williams et al., 2020), urban and peri-urban areas of Bolivia (Jones et al., 2018), older women in Colombia, Ecuador, Mexico, Peru and Chile (Eckhardt et al., 2008; Atalah et al., 2014; Kroker-Lobos et al., 2014; Williams et al., 2020), lower household wealth groups in Ecuador, Mexico and Argentina (Williams et al., 2020; Zapata et al., 2020), lower education levels in Ecuador, Mexico, Colombia, Peru, Bolivia and Argentina (Eckhardt et al., 2008; Batis et al., 2020a; Cediel et al., 2020; Curi-Quinto et al., 2020; Miranda et al., 2020; Williams et al., 2020; Zapata et al., 2020), higher household wealth groups in Peru (Eckhardt et al., 2008), middle household wealth groups in Colombia, Peru and Bolivia (Cediel et al., 2020; Curi-Quinto et al., 2020; Miranda et al., 2020) and non-indigenous groups in Peru, Ecuador and Guatemala (Ramirez-Zea et al., 2014; Curi-Quinto et al., 2020; Ramírez-Luzuriaga et al., 2020); while anaemia in this age group was more common among older women in Colombia, Ecuador and Mexico (Kroker-Lobos et al., 2014; Williams et al., 2020), urban areas in Ecuador and Mexico (Batis et al., 2020a; Williams et al., 2020), lower household wealth groups in Ecuador, Mexico, Peru, Colombia, Bolivia and Argentina (Rivera & Sepúlveda, 2003; Eckhardt et al., 2008; Batis et al., 2020a; Cediel et al., 2020; Miranda et al., 2020; Williams et al., 2020; Zapata et al., 2020), rural areas in Peru and Bolivia (Eckhardt et al., 2008; Jones et al., 2018), lower education levels in Peru, Mexico, Colombia and Bolivia (Eckhardt et al., 2008; Batis et al., 2020a; Cediel et al., 2020; Miranda et al., 2020), increased parity in Peru and Mexico (Eckhardt et al., 2008), middle education levels in Peru (Curi-Quinto et al., 2020), non-indigenous groups in Bolivia (Miranda et al., 2020) and indigenous groups in Ecuador and Guatemala (Ramirez-Zea et al., 2014; Ramírez-Luzuriaga et al., 2020). Studies conducted among adolescents reported higher prevalence estimates of overweight/obesity among those in the higher household wealth groups, higher maternal education levels, urban areas and non-indigenous groups in Mexico (Batis et al., 2020a), lower and medium maternal education levels in Colombia (Cediel et al., 2020), lower household wealth groups and lower maternal education levels in Bolivia (Miranda et al., 2020) and Afro-Ecuadorian adolescents in Ecuador (Ramirez-Luzuriaga et al., 2020); while anaemia among adolescents was more prevalent in the lower household wealth groups in Colombia, Mexico and Bolivia (Sarmiento et al., 2014; Batis et al., 2020a; Cediel et al., 2020; Miranda et al., 2020), indigenous groups in Colombia and Bolivia (Cediel et al., 2020; Miranda et al., 2020) and medium maternal education level in Bolivia (Miranda et al., 2020). Studies among school-age children overall reported higher prevalence estimates of overweight/obesity in lower maternal education levels, urban areas and certain regions of Mexico (Rivera et al., 2003), females in Mexico (Rivera et al., 2003), males in Ecuador and Colombia (Freire et al., 2014; Sarmiento et al., 2014), higher household wealth groups in Mexico and Colombia (Rivera et al., 2003; Sarmiento et al., 2014); while anaemia among school-age children was more common in indigenous groups, rural areas and certain regions of Mexico (Rivera et al., 2003).

At the household level, the form maternal overweight/obesity and childhood anaemia within the same household was more prevalent in peri-urban areas of Bolivia (Jones et al., 2018).

At the individual level, the burden of the co-occurrence of overweight/obesity and anaemia among WRA was concentrated among older women in Colombia and Ecuador (Williams et al., 2020), lower household wealth groups in Ecuador and Mexico (Williams et al., 2020) and mildly and moderately food insecure households in Mexico (Jones et al., 2017). Another article investigating the individual-level DBM among WRA found no differences between indigenous and non-indigenous groups (Ramirez-Zea et al., 2014). In children under-5, the co-occurrence of overweight/obesity and anaemia was more prevalent among younger children in Colombia and Mexico (Engle-Stone et al., 2020), and those living in peri-urban areas in Bolivia (Jones et al., 2018).

Figure 2.5. Map displaying countries within the Americas region included in the review.

Trends in the magnitude of overweight/obesity and/or anaemia were documented in four countries. In Mexico, the prevalence of overweight/obesity increased among children under-5, school-age children, adolescents and adults; while anaemia declined among children under-5, school-age children and WRA between the 1990s and 2012 (Rivera et al., 2009; Kroker-Lobos et al., 2014). Differences in trends of overweight/obesity and anaemia among population subgroups were also reported (Rivera et al., 2009). In Brazil, there was no increase in overweight/obesity between 1996 and 2006-2007 among children under-5; while all other age groups showed a significant increase, particularly among male adults (in females, the incidence reached a plateau or decreased) and those in the poorest and richest household wealth groups (Conde & Monteiro, 2014). In Peru, overweight/obesity increased from 1996 to 2011 among WRA (rates of obesity doubled); childhood overweight/obesity decreased in rural but not urban areas since 2005; and anaemia decreased in both, women and children, with a higher reduction in urban than rural children (Loret-de-

Mola et al., 2014). Conversely, another study based in the Peruvian Amazon found substantially higher rates of anaemia and obesity in 2013 compared to 1970 among women (Tallman et al., 2022). In Guatemala, overweight/obesity among WRA significantly increased between 1998 and 2008 (faster in indigenous than non-indigenous populations); while childhood overweight/obesity decreased in indigenous children only (Ramirez-Zea et al., 2014).

In terms of micronutrient deficiencies, ten studies presented prevalence data on micronutrients: iron (n=9), vitamin A (n=4), zinc (n=8), folate (n=3), folic acid (n=1), vitamin B12 (n=4), vitamin D (n=1), vitamin C (n=2), cooper (n=1), calcium (n=1), selenium (n=1).

2.4.5. Southeast Asian region

There were 13 studies, published between 2006 and 2021, retrieved from the search that involved countries located within the Southeast Asian region. Most evidence on the magnitude of the DBM was from India (**Figure 2.6**). Studies were based in five different countries: Bangladesh (n=2), India (n=6), Indonesia (n=2), Sri Lanka (n=2) and Thailand (n=1). One study was multicountry and multiregional (Engle-Stone et al., 2020). Of the 13 studies, four were primary research and nine were secondary analyses of varied data sources: South East Asian Nutrition Survey (SEANUTS; n=2), DHS or National Family Health Survey (NFHS; n=5), and data from the BRINDA project (n=1). One article utilised multiple data sources (India State-Level Disease Burden Initiative Malnutrition Collaborators, 2019). Nine studies were classified as being conducted at the national level; while four only included a particular population subgroup (e.g., rural residents only).

In the identified studies, the DBM was measured at the population (n=11), household (n=3) and individual (n=5) levels (**Table 2.3**). The DBM was quantified among WRA (n=6), children under-5 (n=5), school-age children (n=1) and adolescents (n=1). Two studies included data among adults, both males and females, aged 19 to >65 years old (Lee & Ryu, 2018; Little et al., 2020). Additionally, two studies encompassed children from 0.5 years to 13 years old (Rojroongwasinkul et al., 2013; Sandjaja et al., 2013).

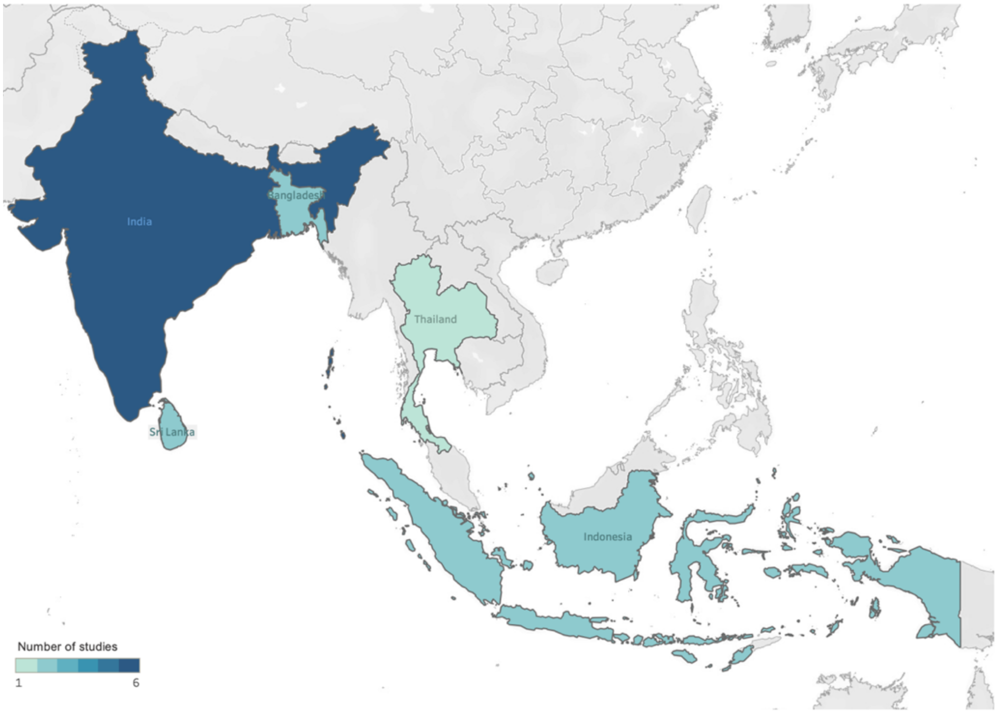
Stratified prevalence estimates were calculated in 12 studies by one or more sociodemographic characteristics (**Table 2.4**). At the population level, childhood overweight/obesity was more prevalent in states with higher sociodemographic index in India (India State-Level Disease Burden Initiative Malnutrition Collaborators, 2019);

while the burden of childhood anaemia was concentrated among rural residents in Bangladesh (Engle-Stone et al., 2020) and certain regions of India (India State-Level Disease Burden Initiative Malnutrition Collaborators, 2019). Among women, overweight/obesity was concentrated in urban areas, higher education levels, higher household wealth groups, and Muslim women and other religious groups in India (Bharati et al., 2019; Sethi et al., 2020); while anaemia was more prevalent among rural residents, lower household wealth groups, lower education levels, Hindu women, and states with higher sociodemographic index in India (Bharati et al., 2019; India State-Level Disease Burden Initiative Malnutrition Collaborators, 2019). One study among adolescents in Sri Lanka found that the prevalence of overweight/obesity was higher in urban areas and in females; while the opposite was observed for anaemia, with higher prevalence estimates in males across all age groups, except in the 14-15 year age group (Jayatissa & Ranbanda, 2006). Two studies reporting estimates among children (0.5-13 years old) found higher prevalence of overweight/obesity in urban areas of Thailand and Indonesia (Rojroongwasinkul et al., 2013; Sandjaja et al., 2013); whereas anaemia was more prevalent in rural areas of Thailand (Rojroongwasinkul et al., 2013). Another study among school-age children in Sri Lanka found higher prevalence of anaemia among younger children and regions farther away from the main cities; whereas overweight/obesity was more common with increased age (Naotunna et al., 2017). Additionally, one study among adults living in Malang (Indonesia), reported higher bivariate estimates of obesity and anaemia among females, when compared to males (Lee & Ryu, 2018).

At the household level, maternal overweight and childhood anaemia in Bangladesh was associated with certain regions and rural areas, unemployed mothers, secondary education level among fathers and mothers, higher household wealth groups and having improved toilet facilities (Mamun & Mascie-Taylor, 2019). Another study, based in India, investigating maternal overweight and childhood undernutrition (including childhood anaemia), reported higher estimates of DBM among older mothers (35 years or older), higher maternal education levels, c-section delivery, child's age, boys, highest household wealth groups, Muslim families, urban areas and certain regions (Kumar et al., 2021).

At the individual level, the co-occurrence of overweight/obesity and anaemia among WRA was higher in higher household wealth groups in India (Sethi et al., 2020). In two studies involving adults, both males and females, the intra-individual DBM was higher among women in India and Indonesia (Lee & Ryu, 2018; Little et al., 2020) and higher caste groups, higher household wealth groups and urban areas in India (Little et al., 2020).

Figure 2.6. Map displaying countries within the Southeast Asian region included in the review.

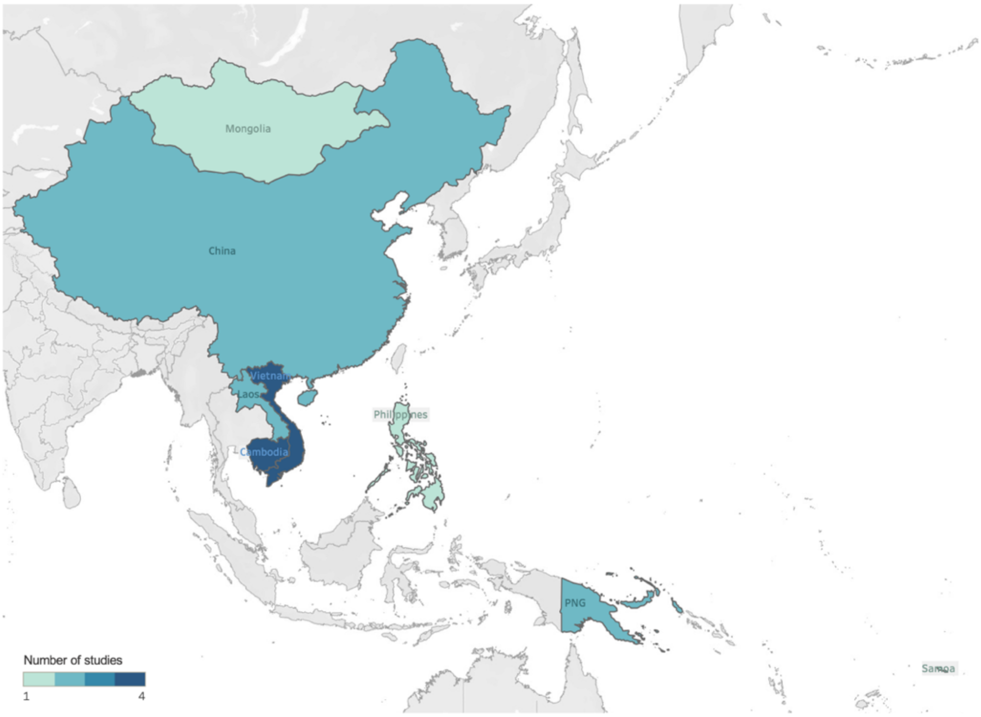


Trends in the magnitude of overweight/obesity and/or anaemia were documented in India. Evidence from two studies report overall increasing trends in childhood and maternal overweight/obesity, and decreasing trends in anaemia among WRA (India State-Level Disease Burden Initiative Malnutrition Collaborators, 2019; Sethi et al., 2019). Micronutrient deficiencies were present in four studies: iron (n=4), vitamin A (n=3), zinc (n=1) and vitamin D (n=2).

2.4.6. Western Pacific region

The search yielded nine records, published between 2005 and 2019, which encompassed countries within the Western Pacific region. Studies were based in eight different countries: Cambodia (n=4), China (n=2), Laos (n=2), Mongolia (n=1), Papua New Guinea (n=2), Philippines (n=1), Samoa (n=1) and Vietnam (n=4) (**Figure 2.7**). Two studies were multicountry and multiregional (Engle-Stone et al., 2020; Williams et al., 2020). Of the nine studies, five were secondary data analyses of nationally representative data and four were primary research at the subnational level. Data sources utilised in studies conducting secondary analysis involved: DHS (n=2), the Chinese National Nutrition Survey (n=1), and data from the BRINDA project (n=2).

Figure 2.7. Map displaying countries within the Western Pacific region included in the review.



In the identified studies, the DBM was measured at the population (n=9) and individual (n=5) levels (**Table 2.3**). There were no studies investigating the intra-household DBM defined as maternal overweight/obesity and childhood anaemia or maternal anaemia and childhood overweight/obesity. The DBM was quantified among WRA (n=3), children under-5 (n=4), children (n=1), and adolescents (n=2).

Stratified prevalence estimates were calculated in all nine studies by one or more sociodemographic characteristics (**Table 2.4**). At the population level, the burden of childhood overweight/obesity was concentrated among older children (>24 months) in Papua New Guinea (Engle-Stone et al., 2020), males in Papua New Guinea and Cambodia (Greffeuille et al., 2016a; Engle-Stone et al., 2020), younger children (<24 months) in Vietnam (Engle-Stone et al., 2020), higher maternal education levels in Philippines and Cambodia (Greffeuille et al., 2016a; Engle-Stone et al., 2020), urban areas in Cambodia (Greffeuille et al., 2016a) and higher household wealth groups in Cambodia and Samoa (Greffeuille et al., 2016a; Choy et al., 2017); while anaemia in children under-5 was more common among younger children in Cambodia, Laos, Mongolia, Papua New Guinea, Vietnam and Samoa (Greffeuille et al., 2016a; Choy et al., 2017; Engle-Stone et al., 2020), rural areas in Papua New Guinea and Cambodia (Greffeuille et al., 2016a; Engle-Stone et al., 2020), lower maternal education levels in Philippines (Engle-Stone et al., 2020), lowest household wealth groups in Cambodia (Greffeuille et al., 2016a) and anaemia among mothers in Samoa

(Choy et al., 2017). Among WRA, overweight/obesity was associated with older age in Cambodia, Laos and Vietnam (Laillou et al., 2014; Greffeuille et al., 2016b; Williams et al., 2020), urban areas in Papua New Guinea, Cambodia and Vietnam (Laillou et al., 2014; Greffeuille et al., 2016b; Williams et al., 2020), higher household wealth groups in Laos, Cambodia and Vietnam (Laillou et al., 2014; Greffeuille et al., 2016b; Williams et al., 2020), middle household wealth group in Cambodia (Williams et al., 2020), lower education levels in Cambodia and Vietnam (Laillou et al., 2014; Greffeuille et al., 2016b) and the Kinh ethnic group in Vietnam (Laillou et al., 2014); while anaemia was more prevalent in rural areas of Papua New Guinea and Cambodia (Greffeuille et al., 2016b; Williams et al., 2020), lower household wealth groups in Laos and Cambodia (Greffeuille et al., 2016b; Williams et al., 2020), those aged 30-39 in Cambodia (Williams et al., 2020) and lower education levels in Cambodia (Greffeuille et al., 2016b). Additionally, two studies based in China among adolescents and children, reported higher estimates of overweight/obesity in boys (Shi et al., 2005), higher paternal education levels (Shi et al., 2005), higher household wealth groups (Shi et al., 2005) and cities (Zou et al., 2016); while anaemia was more prevalent in girls (Shi et al., 2005), in certain regions and schools (Shi et al., 2005) and rural areas for adolescents only (Zou et al., 2016).

At the individual level, the burden of the co-occurrence of overweight/obesity and anaemia among WRA was concentrated in older women in Cambodia, Papua New Guinea and Vietnam, middle household wealth group in Cambodia and higher household wealth groups in Laos and Papua New Guinea (Williams et al., 2020). Among children under-5, the intra-individual DBM was more prevalent in the lower household wealth groups in Philippines (Engle-Stone et al., 2020). Another study investigating the co-occurrence of overweight/obesity and anaemia among children and adolescents in China reported higher estimates among females than males (Zou et al., 2016).

Trends in the magnitude of overweight/obesity and/or anaemia were documented in two studies based in Cambodia. Among children under-5, anaemia decreased between 2000-2005 and remained stable at 45% until 2014; while overweight/obesity did not seem to change over the years despite an increasing trend in the higher household wealth groups and urban areas (Greffeuille et al., 2016a). Among WRA, Cambodia experienced a significant increase in overweight/obesity from 2000 to 2014; while anaemia remained stagnant at 45% (Greffeuille et al., 2016b).

In terms of micronutrient deficiencies, four studies presented prevalence estimates on specific micronutrient deficiencies: iron (n=3), vitamin A (n=2), zinc (n=3), folate (n=3), vitamin B12 (n=3) and vitamin D (n=3).

2.5. Summary of findings (part II): association between overweight/obesity and anaemia

Of the 72 studies included in the review, 20 quantified whether the components of the DBM (i.e., overweight/obesity and anaemia) were independent from each other at the different levels (i.e., population, household or individual levels). Findings are summarised in **Table 2.5**.

Overall, there were three studies from the African region, one from the Eastern Mediterranean region, two from the European region, nine from the Americas region, one from the Southeast Asian region, one from the Western Pacific region and three multiregional. Studies based in one country only were from: South Africa (n=1), Malawi (n=1), Tunisia (n=1), Azerbaijan (n=1), Tajikistan (n=1), Brazil (n=3), Ecuador (n=1), Mexico (n=2), Guatemala (n=1), Colombia (n=1), Bolivia (n=1), India (n=1) and Vietnam (n=1). Additionally, there were three multicountry studies.

The association between overweight/obesity and anaemia was quantified at the population (n=1), household (n=5) and individual levels (n=19). Population groups of interest included: WRA (n=15), children under-5 (n=7), school-age children (n=5), adolescent girls (n=1) and adult women (n=1). All studies investigating the independence of overweight/obesity and anaemia at the household level (i.e., maternal overweight/obesity and childhood anaemia or maternal anaemia and childhood overweight/obesity) focused on mother-child dyads.

Studies utilised various methods to document the association between the two forms of malnutrition; however, by far the most repetitive method was the comparison between the observed and expected DBM prevalence estimates. The expected prevalence in these studies was generated as the product of the components of each double burden based on the sample of individuals or households for whom the double burden was calculated (the multiplicative rule of probability).

Findings across studies included in **Table 2.5** are mixed, but most suggest that individuals who are living with overweight/obesity have lower rates of anaemia, and that observed prevalence estimates did not differ greatly from expected values, with some exceptions across LMICs and different age groups.

Table 2.5. Key findings on the association between overweight/obesity and anaemia in the included studies.

Author(s), year	Country	DBM level	Method	Study population	Summary of findings
AFRICAN REGION					
Jinabhai et al., 2001	South Africa	Individual	Chi-squared tests	SC (8-10y)	Significant association (p<0.05) between BMI (i.e., obesity) and haemoglobin <12g/dl
Jones et al., 2016a	Multicountry* (n=30)	Population	Cluster-level mean population densities and the Moran' s I statistic to added spatial autocorrelation by use of geolocated DHS data	WRA	Cluster-level BMI values and haemoglobin concentrations were spatially correlated.
		Individual	Observed vs. expected prevalence	WRA	O % of DBM > the E % in the peri-urban and urban areas of West Africa, as well as in the semirural and urban areas of East Africa.
Rhodes et al., 2020	Malawi	Individual	Observed vs. expected prevalence Rao-Scott modified chi-squared tests	WRA	O % of DBM (3.7%); E % (3.1%) (p-value= 0.49).
EASTERN MEDITERRANEAN REGION					
Sassi et al., 2019	Tunisia	Household	Multinominal regressions	Mother-child dyads	No synergetic nor antagonistic co-occurrence for either anaemia in child and overweight in mother (IPR = 1·0; 95 % CI 0·9, 1·1, p-value= 0·59) or anaemic child and obesity in mother (IPR = 1·1; 95 % CI 0·9, 1·2, p-value= 0·40).
EUROPEAN REGION					
Wirth et al., 2018	Azerbaijan	Individual	Poisson regression models	WRA	The risk of anaemia was lower in women living with OWOB (p-value<0.05). >40% of the risk of anaemia in WRA was explained by iron deficiency alone.
				PSC	OWOB was not associated with anaemia; but PSC with recent LRI, inflammation and iron deficiency had 1.5 to > 2-fold increased risk of being anaemic.
Barth-Jaeggi et al., 2020	Tajikistan	Household	Generalised least squares random effect model	Mother-child dyads	Children living in the same households as women with a mean BMI >25 kg/m2 had increased Hb of 0.3 g/dl compared with those living in a household without OWOB women.
		Individual		WRA	Women's BMI was negatively correlated with ID (r= -0.067, p-value = 0.003) and IDA (r= -0.064, p-value= 0.005), but positively with inflammation (r= 0.199, p-value < 0.000).

SC: school-age children; WRA: women of reproductive age; PSC: children under-5; BMI: body mass index; O: observed prevalence; E: expected prevalence; DBM: double burden of overweight/obesity and anaemia; OWOB: overweight/obesity; LRI: lower respiratory infection; ID: iron deficiency; IDA: iron deficiency anaemia.
*LMICs included in Jones et al., 2016a: Benin, Burkina Faso, Cote d'Ivoire, Ghana, Guinea, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, DRC, Congo, Cameroon, Gabon, STP, Burundi, Ethiopia, Kenya, Rwanda, Tanzania, Uganda, Lesotho, Madagascar, Malawi, Mozambique, Namibia, Swaziland, Zambia and Zimbabwe.

Table 2.5. (continued)

Author(s), year	Country	DBM level	Method	Study population	Summary of findings
AMERICAS REGION					
Novaes Oliveira et al., 2010	Brazil	Individual	Contingency tables and a log-linear model; t-tests and chi-squared tests; observed vs. expected prevalence	PSC	Data treated as continuous variables: positive correlations between Hb levels and WAZ, even controlled for age. For each 1g/L increased in Hb, WAZ scores increased by 0.02. Data treated as dichotomous variables: no significant difference between the O and E % (p>0.05)
Conde and Monteiro, 2014	Brazil	Individual	Observed vs. expected prevalence	WRA (12-49y)	O % of DBM (13.6%); E % (13.5%) (p-value=0.567). Separation of the 15-24 and 25-49 y age ranges also showed no association.
				SC (5-11y)	O % of DBM (1.3%); E % (1.3%) (p-value=0.821).
Freire et al., 2014	Ecuador	Household	Observed vs. expected prevalence	Mother-child dyads	O % of maternal OWOB and childhood anaemia (12.6%); E % (14.1%) (p-value=0.057).
		Individual		WRA (12-49y)	O % of DBM (8.9%); E % (8.8%) (p-value=0.664).
				SC (5-11y)	O % of DBM (0.7%); E % (1.0%) (p-value=0.133).
Kroker-Lobos et al., 2014	Mexico	Individual	Observed vs. expected prevalence	WRA (12-49y)	O % of DBM (7.6%); E % (7.2%) (p-value=0.037).
				SC (5-11y)	O % of DBM (2.9%); E % (3.4%) (p-value=0.001).
Ramirez-Zea et al., 2014	Guatemala	Individual	Observed vs. expected prevalence	WRA	Whole population: O % of DBM (11.7%); E % (12.7%) (p-value<0.001). Indigenous: O % of DBM (12.7%); E % (13.3%) (p-value=0.034). Non-indigenous: O % of DBM (11.2%); E % (12.3%) (p-value<0.001).
				PSC	Whole population: O % of DBM (1.4%); E % (1.6%) (p-value=0.011). Indigenous: O % of DBM (1.1%); E % (1.2%) (p-value=0.188). Non-indigenous: O % of DBM (1.7%); E % (2.0%) (p-value=0.030).
Sarmiento et al., 2014	Colombia	Individual	Observed vs. expected prevalence	WRA (13-49y)	O % of DBM (3.4%); E % (3.5%) (p-value=0.038).
				SC (5-12y)	O % of DBM (1.4%); E % (1.5%) (p-value=0.037).
Jardim-Botelho et al., 2016	Brazil	Individual	Chi-squared tests	PSC	Anaemia % similar in normal weight vs. OWOB: 69% (normal weight) vs. 67% (OWOB), p-value=0.46.

SC: school-age children; WRA: women of reproductive age; PSC: children under-5; O: observed prevalence; E: expected prevalence; DBM: double burden of overweight/obesity and anaemia; OWOB: overweight/obesity; Hb: haemoglobin levels; WAZ: weight-for-age Z scores.

Table 2.5. (continued)

Author(s), year	Country	DBM level	Method	Study population	Summary of findings
AMERICAS REGION					
Jones et al., 2017	Mexico	Individual	Observed vs. expected prevalence	Adult women (20-49y)	O % of DBM (9.2%); E % (9.4%).
				Adolescent girls (15-19y)	O % of DBM (1.8%); E % (2.7%).
Jones et al., 2018	Bolivia	Household	Observed vs. expected prevalence	Mother-child dyads	O % > E% for maternal overweight/obesity and childhood anaemia in urban, peri-urban and rural areas (p-value<0.05).
		Individual		WRA	O % < E % for DBM in urban (p-value<0.05), peri-urban (p-value>0.05) and rural areas (p-value>0.05)
				PSC	O % < E % for DBM in urban (p-value>0.05), peri-urban (p-value<0.05) and rural areas (p-value>0.05)
SOUTHEAST ASIAN REGION					
Varghese & Stein, 2019	India	Household	Observed vs. expected prevalence	Mother-child dyads	Maternal OWOB and anaemia: of the 36 states, 0 had O % > than E %; while 21 had O % < than E %. Of the 640 districts, 3 had O % > than E %; while 64 had O % < than E %. Maternal anaemia and childhood OWOB: of the 36 states, 0 had O % > than E %; while 4 had O % < than E %. Of the 640 districts, 0 had O % > than E %; while 0 had O % < than E %.
		Individual		WRA	Of the 36 states, 0 had O % > than E %; while 31 had O % < than E %. Of the 640 districts, 3 had O % > than E %; while 285 had O % < than E %.
				PSC	Of the 36 states, 3 had O % > than E %; while 2 had O % < than E %. Of the 640 districts, 0 had O % > than E %; while 0 had O % < than E %.
WESTERN PACIFIC REGION					
Laillou et al., 2014	Vietnam	Individual	Linear regressions; Rao-Scott chi-Square Tests	WRA	Hb levels (as well as ferritin and retinol concentrations) were significantly lower for underweight and normal weight, compared to OWOB (p-value<0.05)

WRA: women of reproductive age; PSC: children under-5; O: observed prevalence; E: expected prevalence; DBM: double burden of overweight/obesity and anaemia; OWOB: overweight/obesity; Hb: haemoglobin levels.

Table 2.5. (continued)

Author(s), year	Country	DBM level	Method	Study population	Summary of findings
MULTIREGIONAL					
Eckhardt et al., 2008	Multicountry* (n=3)	Individual	Logistic regressions	WRA (18-49y)	Egypt: WRA with OWOB had significantly lower odds of anaemia than non-OWOB (OR= 0.78, 95% CI: 0.68, 0.90). Peru: WRA with OWOB had lower odds of anaemia than non-OWOB (OR= 0.83, 95% CI: 0.71, 0.96). Mexico: no differences in the odds of anaemia by BMI group.
Engle-Stone et al., 2020	Multicountry* (n=20)	Individual	Observed vs. expected prevalence; Rao–Scott chi-square tests	PSC	Bangladesh 2010 O (1.2%) vs. E (1.4%); Bangladesh 2012 O (1.0%) vs. E (1.1%); Cambodia 2014 O (0.0%) vs. E (0.0%); Laos 2006 O (0.0%) vs. E (0.3%); Mongolia 2006 O (1.3%) vs. E (0.0%); PNG 2005 O (1.5%) vs. E (2.3%); Philippines 2011 O (0.6%) vs. E (0.8%); Vietnam 2010 O (0.0%) vs. E (0.3%); Cote d' Ivoire 2007 O (3.7%) vs. E (3.8%); Cameroon 2009 O (1.7%) vs. E (1.8%); Kenya 2007 O (3.5%) vs. E (3.1%); Kenya 2010 O (3.3%) vs. E (3.2%); Liberia 2011 O (1.2%) vs. E (1.3%); Malawi 2016 O (2.6%) vs. E (1.4%)a; Colombia 2010 O (0.6%) vs. E (0.5%); Ecuador 2012 O (1.2%) vs. E (1.8%)a; Mexico 2006 O (1.0%) vs. E (1.5%); Mexico 2012 O (1.5%) vs. E (1.5%); Nicaragua 2005 O (1.2%) vs. E (1.3%); Afghanistan 2013 O (1.9%) vs. E (2.9%); Azerbaijan 2013 O (3.5%) vs. E (4.0%); Georgia 2009 O (5.0%) vs. E (4.5%); Pakistan 2011 O (2.8%) vs. E (2.8%). In Malawi children with OWOB were more likely to have anaemia than non OWOB; while children with OWOB living in Ecuador were less likely to have anaemia.
Williams et al., 2020	Multicountry* (n=14)	Individual	Observed vs. expected prevalence; Rao–Scott chi-square tests	WRA	Mexico 2012 O (9.9%) vs. E (similar); Mexico 2006 O (9.0%) vs. E (similar); Ecuador 2012 O (8.5%) vs. E (similar); Colombia 2010 O (3.5%) vs. E (similar); Azerbaijan 2013 O (8.7%) vs. E (similar); Georgia 2009 O (10.3%) vs. E (similar); Afghanistan 2013 O (18.6%) vs. E (similar); Pakistan 2011 O (15.4%) vs. E (higher)a; Cameroon 2009 O (8.9%) vs. E (higher)a; Cote d' Ivoire 2007 O (11.9%) vs. E (similar); Malawi O (3.6%) vs. E (similar); PNG 2005 O (5.3%) vs. E (higher)a; Laos 2006 O (4.8%) vs. E (similar); Cambodia 2014 O (8.6%) vs. E (similar); Vietnam 2010 O (1.0%) vs. E (similar). DBM % in Pakistan, Cameroon and PNG was 3pp lower than expected (p<0.001), indicating lower odds of anaemia among OWOB women.

WRA: women of reproductive age; PSC: children under-5; O: observed prevalence; E: expected prevalence; DBM: double burden of overweight/obesity and anaemia; OWOB: overweight/obesity; pp: percentage points.
*LMICs included in Eckhardt et al., 2008: Mexico, Peru and Egypt.
**LMICs included in Engle-Stone et al., 2020: Bangladesh, Cambodia, Laos, Mongolia, Papua New Guinea, Philippines, Vietnam, Cote d' Ivoire, Cameroon, Kenya, Liberia, Malawi, Colombia, Ecuador, Mexico, Nicaragua, Afghanistan, Azerbaijan, Georgia and Pakistan.
***LMICs included in Williams et al., 2020: Mexico, Ecuador, Colombia, Azerbaijan, Georgia, Afghanistan, Pakistan, Cameroon, Cote d' Ivoire, Malawi, Papua New Guinea, Cambodia, Laos and Vietnam.
(a) significant associations (p-value<0.05).

2.6. Gaps in research

This overview of the literature mapped and summarised the existing evidence from LMICs preceding the research conducted within this thesis on the double burden of overweight/obesity and anaemia across the life-course. The search of published studies with no limit of year of publication in PubMed revealed important gaps in research, particularly on the magnitude and distribution of the DBM at the individual and household levels. The first identified study quantifying the magnitude of both components of the DBM was from 2001; yet, over 50% of studies were from the past five years, and 24/75 (32%) were conducted from 2020 onwards. The first identified study investigating the magnitude of the intra-individual DBM (i.e., concurrent overweight/obesity and anaemia within the same individual) was from 2010; and 2014 for the intra-household DBM (i.e., maternal overweight/obesity and childhood anaemia or maternal anaemia and childhood overweight/obesity within the same household). The dearth of evidence on the magnitude and distribution of the DBM from earlier years might be due to the fact that the concept of the "double burden of malnutrition" was only presented for the first time in 1992 at the International Conference on Nutrition (ICN). Before then, overweight/obesity and forms of undernutrition were commonly understood as two separate problems that needed different solutions, with overweight/obesity perceived mainly as a problem of high-income countries. Nevertheless, it was not until recently, that the common drivers of "opposite" forms of malnutrition were highlighted and widely recognised in the Lancet Series on the DBM (Hawkes et al., 2020). Another plausible explanation for the limited evidence on the magnitude and distribution of the double burden of overweight/obesity and anaemia is the greater focus on the double burden of overweight/obesity and stunting when investigating the DBM (Davis et al., 2020). As mentioned in Chapter 1, the Lancet Series on the DBM only analysed anthropometric data when quantifying the DBM (Popkin et al., 2020). In view of the limited data on micronutrient deficiencies, anaemia has been used as a proxy measure, and it is also one of the 2025 global nutrition targets. This approach is not without limitations (i.e., multifactorial aetiology of anaemia), which are discussed in the subsequent chapters of this thesis.

An interesting finding of part I of this review, is the high number of published studies from the Americas region in comparison with the other WHO regions. Of the 72 studies included, 26 were based in this region, and the three additional multiregional studies also included countries within the Americas region. Six and seven articles were part of a special issue published in 2014 in *The American Journal of Clinical*

Nutrition and another one in 2020 in *Public Health Nutrition*, respectively. This may indicate the particular interest of the Americas region in tackling all forms of malnutrition simultaneously.

Another key finding of part I is the predominant focus on the population-level DBM. Of the 72 studies, 96% (n=69) included prevalence estimates at the population level, 33% (n=24) at the individual level, and 8% (n=6) at the household level. In two regions, the African and Western Pacific, there were no articles quantifying the prevalence of maternal overweight/obesity and childhood anaemia or maternal anaemia and childhood overweight/obesity within households. Likewise, trends are only documented for the population-level DBM. Therefore, this review highlights important gaps in the magnitude and distribution of the intra-individual and intra-household DBM. Although, the search was only conducted in one database (i.e., PubMed), and the grey literature was not searched, the overview of the literature presented in this chapter is likely a good reflection of current evidence and aligns with previous findings (Davis et al., 2020). Furthermore, reports on malnutrition, including those from the DHS, normally include estimates at the population level.

The dearth of research on the DBM at the individual and household levels, seem to indicate that prevalence estimates varied by country and age group under investigation. Likewise, findings from part II of this review (i.e., association between overweight/obesity and anaemia) are mixed. A large number of included studies found similar prevalence estimates to those expected, under the assumption that both forms of malnutrition were independent. Thus, some authors argue that the DBM does not exist, or that it does not constitute a relevant issue within a particular context; while others disagree, highlighting a relatively moderate prevalence of intra-individual DBM, and suggest the need for interventions that tackle all forms of malnutrition among affected individuals.

In line of these observations, it is imperative to better understand how overweight/obesity and anaemia coexist among different age groups living in LMICs, particularly at the individual and household levels. A comprehensive analysis investigating the double burden of overweight/obesity and anaemia could help elucidate, not only how prevalent these two forms are, but also unmask subgroups within LMICs who might be most vulnerable to suffer the DBM. This will allow to inform policy and design appropriate context-specific interventions that tackle all forms of malnutrition more efficiently, as well as reduce health inequalities.

2.7. Chapter summary

In this chapter, the existent literature published before conducting this PhD is mapped and findings are synthesised narratively and in tables. Gaps in research that informed the development of the PhD aims and objectives are also highlighted in this chapter. This review calls for a comprehensive study on the magnitude and distribution of the double burden of overweight/obesity and anaemia at the different levels in LMICs. The next chapter presents the aims and specific objectives of this thesis.

CHAPTER 3

Thesis aim and objectives

3.1. Chapter overview

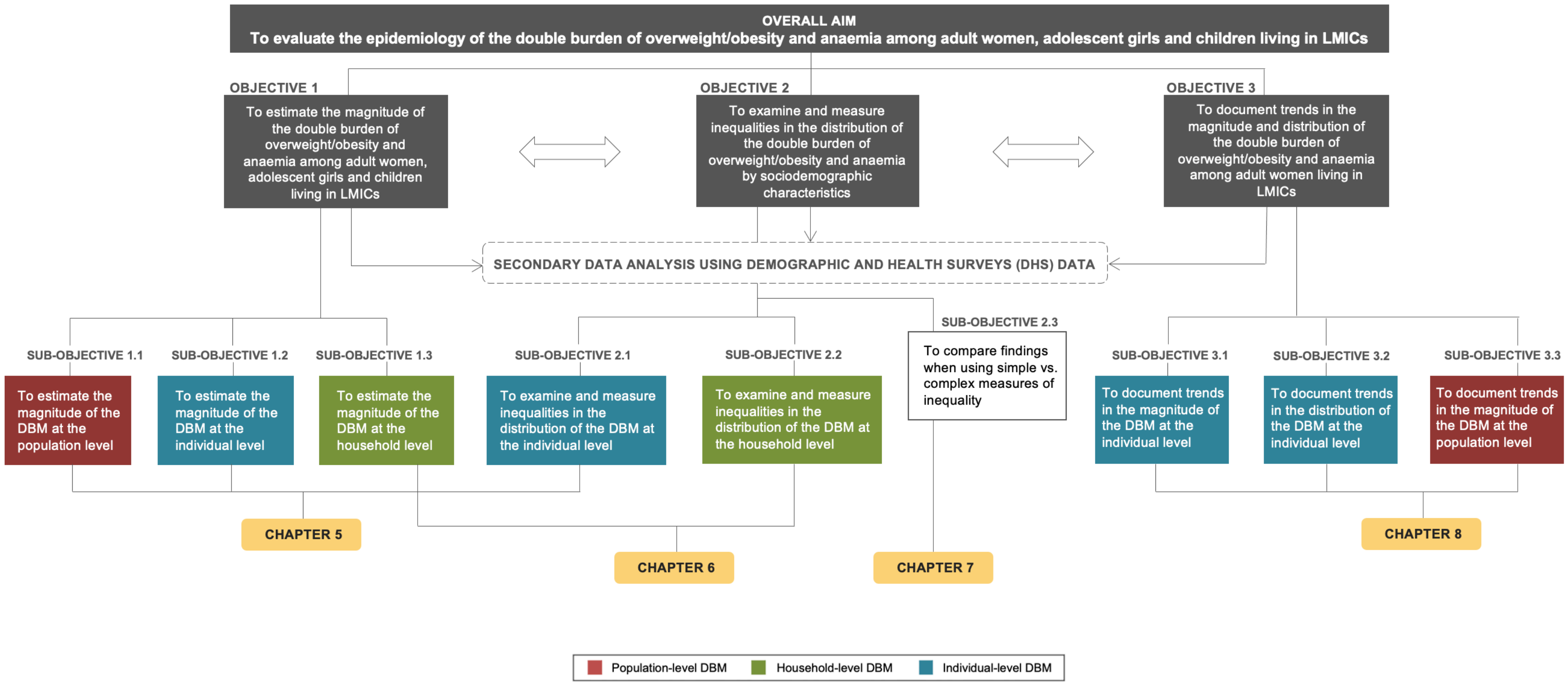
This chapter outlines the overall thesis aim and specific objectives. Chapter 2 highlighted a dearth of studies investigating the magnitude and distribution of the DBM at the individual and household levels, with most available evidence exploring the population-level double burden of overweight/obesity and anaemia. Further, most identified studies were based in the Americas region; while other regions were underrepresented. Likewise, there were no studies documenting trends in the intra-individual or intra-household DBM. In order to maximise efforts to address all forms of malnutrition, the following research questions were developed based on identified gaps: what is the magnitude of the double burden of overweight/obesity and anaemia at the different levels among adult women, adolescent girls and children living in LMICs; how is this DBM distributed across population subgroups; is the DBM increasing or decreasing over time; do trends in the DBM differ by population subgroups? Additionally, this chapter is complemented by a diagram displaying the thesis aim, objectives and sub-objectives.

3.2. Thesis aim and objectives

The overall aim of this thesis is to evaluate the epidemiology of the DBM, defined as the coexistence of overweight/obesity and anaemia, at the three levels (i.e., population, household and individual levels) among adult women, adolescent girls and children living in LMICs (**Figure 3.1**). To achieve the thesis aim, the following individual objectives will be addressed in four chapters:

1. To calculate the magnitude of the double burden of overweight/obesity and anaemia among adult women, adolescent girls and children living in LMICs. This will provide a snapshot of the extent of the coexistence of both forms of malnutrition at the three levels. Prevalence estimates at the population and individual levels are presented in Chapter 5. Prevalence estimates at the household level are disclosed in Chapter 6.

Figure 3.1. Diagram summarising the overall PhD aim, objectives and sub-objectives.



2. To examine and measure inequalities in the distribution of the double burden of overweight/obesity and anaemia among adult women, adolescent girls and children living in LMICs. This will enable the identification of subgroups within the population that are at a higher risk of being affected by the DBM at the individual or household levels. A sub-objective of this includes the comparison of findings when using simple and complex measures of inequalities. Results at the individual level are presented in Chapter 5. Household-level estimates are reported in Chapter 6. Inequality measures are compared in Chapter 7.

3. To document trends in the magnitude and distribution of the double burden of overweight/obesity and anaemia among adult women living in LMICs. This investigation will show how the coexistence of overweight/obesity and anaemia at the individual level among adult women has evolved over time in the different LMICs, overall and for different population subgroups. Trends in the DBM at the population level are also calculated to allow for comparison with the intra-individual level. Findings from this analysis are displayed and discussed in Chapter 8.

3.3. Chapter summary

This chapter highlighted the overall aim and specific objectives of this thesis. The next chapter introduces the data source and methodological approach to address the aim and objectives.

CHAPTER 4

Methods

4.1. Chapter overview

This chapter is divided into two main parts. The first part briefly introduces the data source employed for the different analyses enclosed in this PhD: The Demographic and Health Surveys (DHS). The second part provides a detailed description of the methods used in the different studies (Chapters 5 to 8) to achieve the overall aim and specific objectives set for this thesis. In this second part, the datasets included in the analyses are first described, followed by the study population, measures, and statistical analyses. The DBM at the three levels is defined, and an explanation of how these variables were generated is provided.

4.2. Data source: The Demographic and Health Surveys

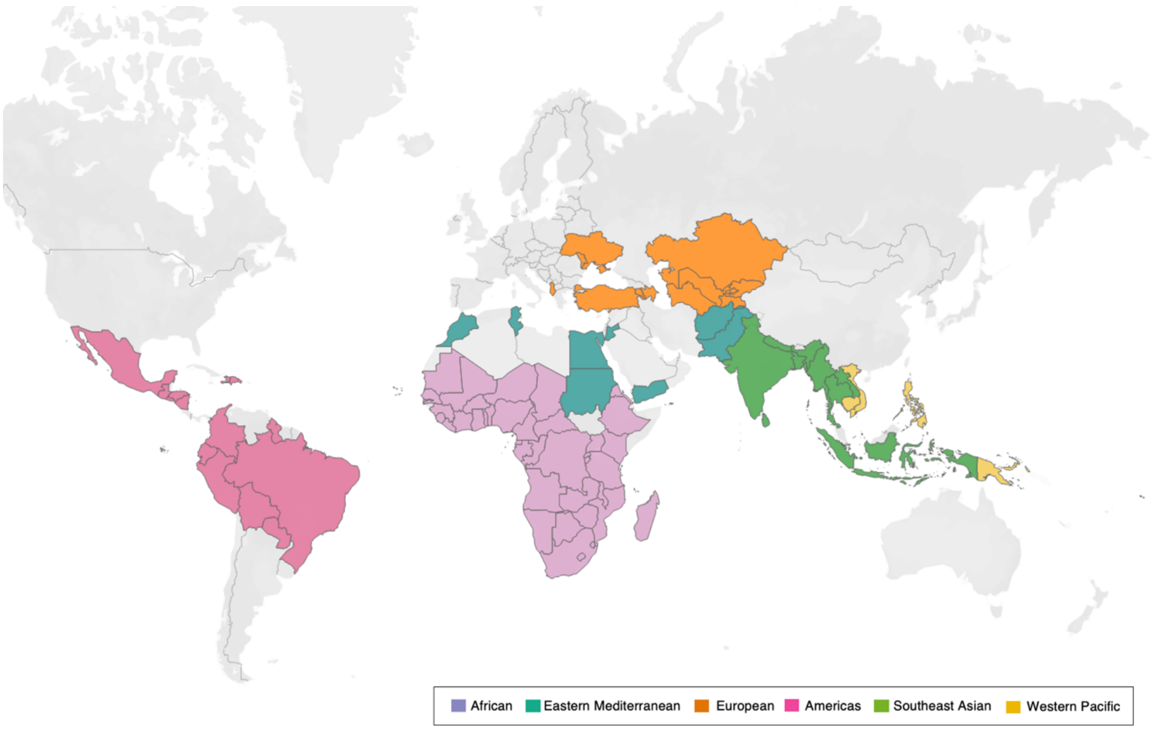
4.2.1. Introduction to the programme

DHS are comparable nationally representative household surveys from over 90 countries, undertaken approximately every five years, since 1984 (**Figure 4.1**). Originally established by the United States Agency for International Development (USAID), the overall aim of DHS surveys is to provide countries on a regular basis with the data needed for monitoring and evaluation purposes in the areas of population, health, and nutrition. Since its inception, there have been eight survey rounds, or eight five-years phases, from DHS-I (1984-1990) to DHS-8 (2018-2023). Data is free, publicly available, and accessible from https://dhsprogram.com, after registration (**Appendix A**). A comprehensive guide to DHS statistics has also been developed, and is available online (Croft et al., 2018).

4.2.2. Questionnaires

In all countries, DHS follows standardised procedures, which includes survey instruments and data collection methods, in order to collect data that are comparable across countries. Model questionnaires are available in the guide to DHS statistics (Croft et al., 2018). Countries typically adopt the model questionnaire in its entirety, but on some occasions, additional questions or modules have been added to comply with a particular country's interest. Briefly, there are four main different questionnaires: i) Household Questionnaire, ii) Biomarker Questionnaire, iii) Woman's Questionnaire, and iv) Man's Questionnaire. WRA (15-49 years old) are the focus of the survey, and consequently, all DHS surveys employ at least the Household and Woman's Questionnaire. The first one is used to gather basic characteristics of each person living in the household, but also to identify women eligible for an individual interview and children under-5 to collect anthropometric measures and be tested for anaemia. The Woman's Questionnaire includes data on themselves and their children under-5, and is divided into ten standard sections: background characteristics, reproduction, contraception, pregnancy and postnatal care, child immunization, child health and nutrition, marriage and sexual activity, fertility preferences, husband's background and woman's work, HIV//AIDS, and other health issues. The Biomarker Questionnaire includes: anthropometric measurements (height and weight), anaemia testing (haemoglobin levels), HIV testing, malaria testing, and other lab-based biomarkers.

Figure 4.1. Countries in the DHS programme by WHO region.

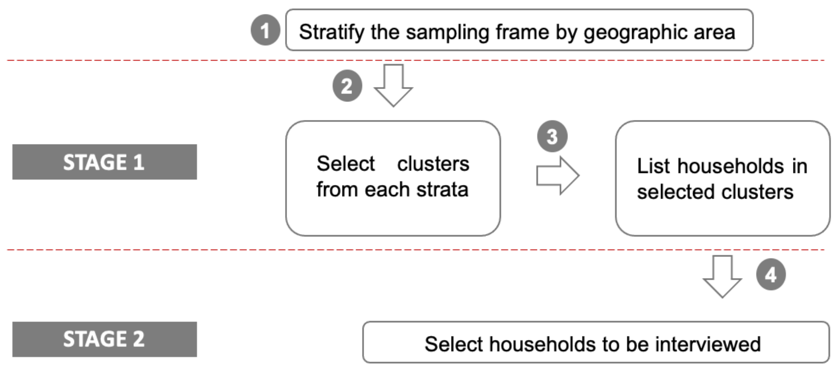


4.2.3. Sample design and stratification

DHS follows a two-stage random sampling technique (**Figure 4.2**). For this, DHS usually uses an existing sample frame, such as the most recent census frame for each country. The sampling frame provides a complete list of clusters, also called primary sampling units (PSUs) or enumeration areas (EAs). Then, units are grouped into homogeneous subgroups (i.e., strata). The rationale behind using a sampling frame and the stratification process is to identify 100% of the target population, so that every individual has the same chance to be selected for an interview, and to allow for a representative sample to be drawn for each subgroup.

In summary, in the first stage, the number of households needed per geographical areas is determined, which will depend on available funding and logistics for each country, and clusters (or census enumeration areas) are randomly selected with probability proportional to size (i.e., clusters with larger populations are more likely to be selected). The second stage consists of a random selection of households within the selected clusters.

Figure 4.2. Overview of the two-stage random sampling technique.



Adapted from *Part I: Introduction to DHS Sampling Procedures*: https://www.youtube.com/watch?v=DD5npelwh80

4.2.4. Recode files for analysis

After data collection has been finalised, the DHS programme releases survey data to the wider public, approximately within 12 months after the end of fieldwork, and once the main survey report has been published in the webpage (Croft et al., 2018). Each dataset is reformatted into standard recode files to facilitate usage and to allow for cross-country comparison analyses. The reformatting process of datasets include the standardisation of variable names and coding categories across countries, and the generation of commonly used variables (e.g., marital status or age in five-year groups). Recode files are available for use on different statistical software, including

Stata, and are exported into several dataset types (**Table 4.1**). There also exist two geographic datasets (GE: Geographic Data and GC: Geospatial Covariates), not included in the table below, as a special registration is required to access this data, and a fieldworker's dataset (FW).

Table 4.1. Types of recode files available in DHS.

Code	Dataset type	Unit of analysis	Data
HR	Household Recode	Households	Household characteristics; household roster; biomarkers rosters
PR	Household members (or Persons) Recode	Household member	Characteristics of household members; biomarker measures
IR	Individual (Women's) Recode	Women	All data collected in the Woman's Questionnaire + some variables from the Household Questionnaire; up to 20 births in the birth history, up to 6 children under-5 for whom pregnancy and postnatal care, immunization, health and nutrition data were collected
BR	Births Recode	Birth	Full birth history of all women interviewed (pregnancy and postnatal care, immunization, health and nutrition data for children born in the last 5 years)
KR	Kids Recode	Child under-5 born to a woman interviewed	Child's pregnancy and postnatal care; immunization; health and nutrition; mother's data
MR	Men's Recode	Men	All data collected in the Man's Questionnaire + some variables from the Household Questionnaire
CR	Couples Recode	Married woman and man	Data for married or living together women and men (the result of linking the IR and MR files)
AR	HIV testing Recode	Person tested for HIV	Result of lab testing for HIV
WI	Wealth Index	Household	Wealth score and quintiles for surveys prior to late 1990's
HW	Height and Weight	Children under-5	z-scores based on the new WHO child growth definition for surveys prior to 2006

Source: *Guide to DHS Statistics* (Croft et al., 2018), available at: https://dhsprogram.com/data/Guide-to-DHS-Statistics/index.cfm

4.2.4. Ethics

Ethical approval for conducting the DHS surveys is obtained centrally by the ORC Macro Institutional Review Board and by individual review boards within the individual countries participating in the programme. Procedures and questionnaires are reviewed and approved by ICF Institutional Review Board (IRB). Informed consent to participate in the study is also taken from the participant (or from a parent or legal guardian for children and unmarried adolescents), before conducting any questionnaire or biomarker tests. All available data in the recode files used for analyses are de-identified, and therefore further ethical clearance is not needed, nor was pursued for the realisation of the present PhD thesis. Additional information on Ethical Review and how the data collected is managed can be found in the DHS webpage: https://dhsprogram.com.

4.3. Methods used in the PhD thesis

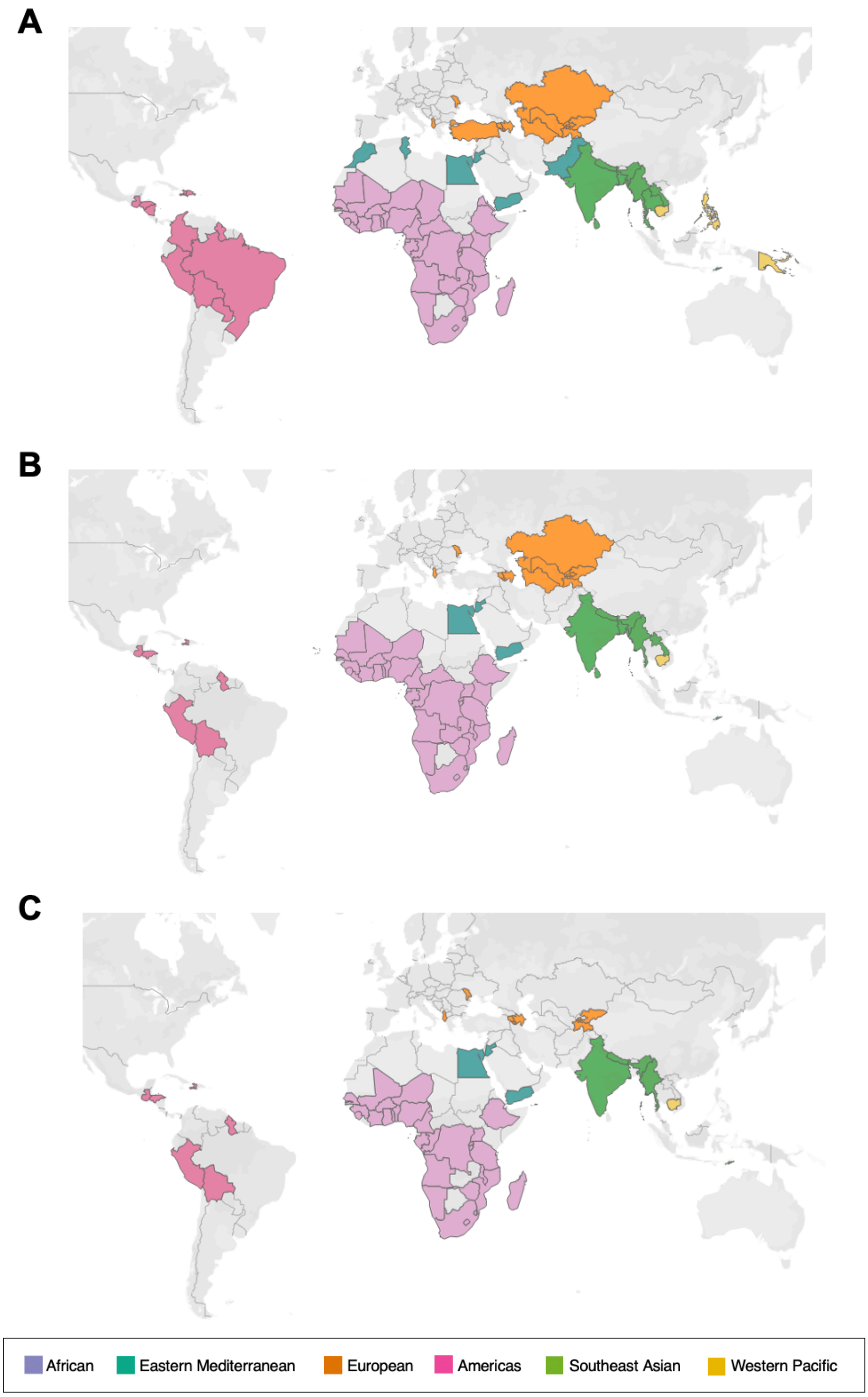
This PhD thesis is a secondary analysis of DHS data, comprised of three independent, but interconnected, quantitative studies to achieve the following objectives:

1) To quantify the magnitude of the double burden of overweight/obesity and anaemia at the three levels among adult women, adolescent girls and children living in LMICs.
2) To explore the distribution of the double burden of overweight/obesity and anaemia at the individual and household levels by sociodemographic characteristics, by use of simple and complex measures of inequalities.
3) To document trends in the intra-individual double burden of overweight/obesity and anaemia among adult women living in LMICs.

4.3.1. Datasets included for the analyses

The most recent datasets from the DHS with available data on anthropometric measures and anaemia testing were used, except to answer the third objective, for which all datasets from countries with at least two datasets with available data among adult women were used. The individual recode files (coded as 'IR') and the children recode files (coded as 'KR') were used for this PhD (**Appendix A**). **Figure 4.3** shows the number of countries with at least one dataset with available data for one or both measures of interest. As can be observed, the total number of countries that collect weight and height data among WRA and/or children under-5 (n=80) is larger than that of anaemia testing (n=65). One of the reasons behind this difference is that anaemia testing only began to be implemented by the DHS programme in the year 2000; whereas there is available anthropometric data since the programme's inception. Objective data on specific micronutrient deficiencies is even lower, with the exception of iodine salt testing (n=72 countries): vitamin A testing (n=3 countries), vitamin D3 testing (n=2 countries), urine iodine excretion (n=2), serum vitamin B12 (n=1 country), serum folate (n=1 country), micronutrient testing (n=3 countries), iron transferrin receptor (n=1 country). After checking the available datasets for each country, the total number of countries with both, anthropometric measures and anaemia testing, and therefore, included in this PhD was 52 (n=51 with data for WRA and n=52 with data for children under-5). The analysis at the household level was conducted across 49 LMICs, which had available anthropometric measures and anaemia testing for the same year for both, children under-5 and WRA (i.e., their mothers). The trends analysis among adult women included a total of 33 LMICs, which had at least two surveys with available data.

Figure 4.3. Countries with at least one DHS survey with available anthropometry measures (A), anaemia testing (B), and both (C).



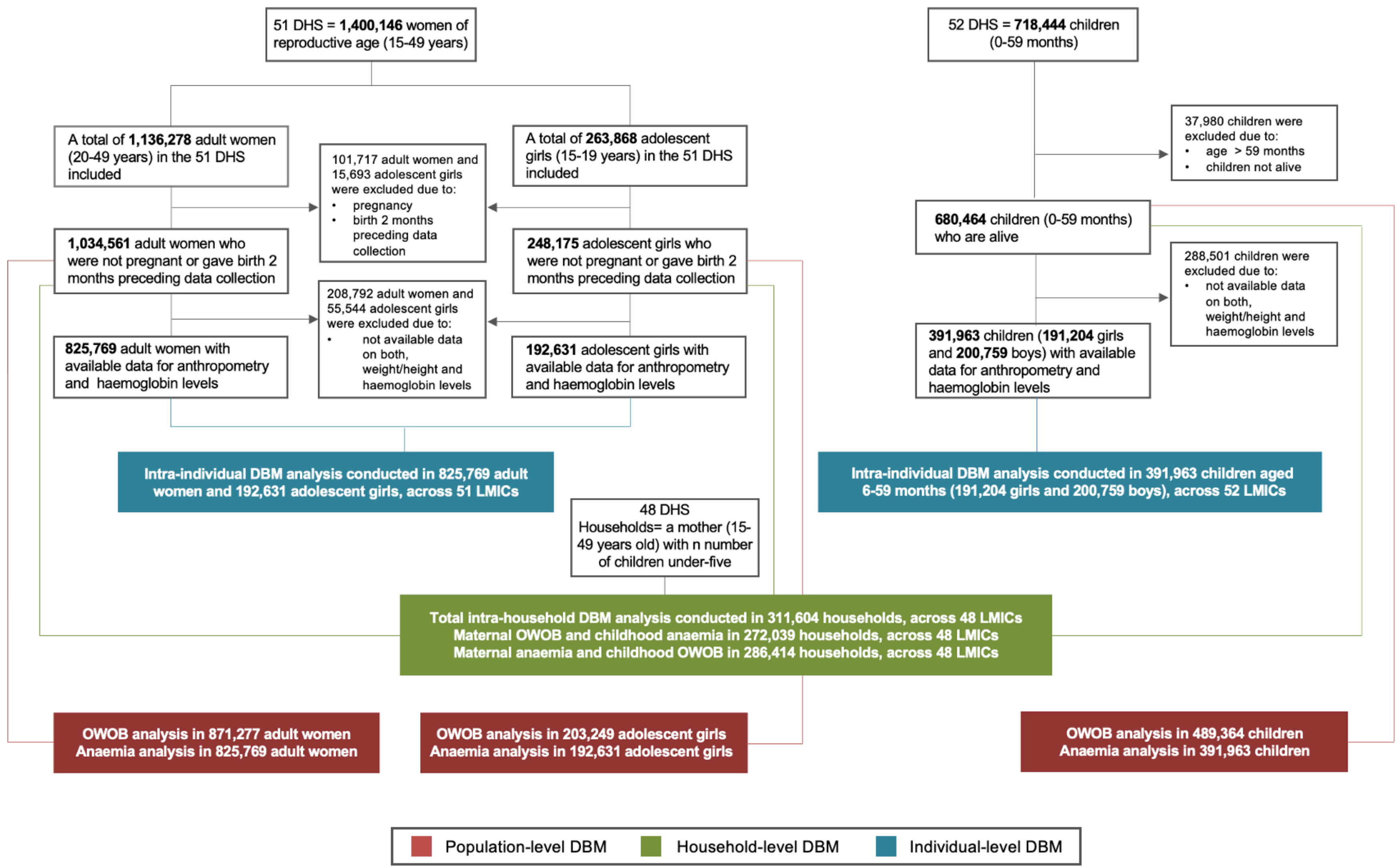
4.3.2. Study population and analytical sample

The population of interest comprised WRA (15-49.9 years old), further categorised into adult women (20-49.9 years old) and adolescent girls (15-19.9 years old), and children under-5 (0-59.9 months old). The decision to provide separate estimates for adolescent girls and adult women was two-fold. On the one side, the adolescent population (defined by the WHO as those aged 10 to 19 years) has historically been under-researched in health and nutrition studies, and as such there is a dearth of literature on the magnitude of the DBM among this population (Caleyachetty et al., 2018). On the other side, adolescence, characterised as a period of rapid growth with higher nutritional demands, has been identified as a second window of opportunity to address the burden of malnutrition and prevent its intergenerational consequences (Wells et al., 2020; Norris et al., 2021). Thus, although DHS does not normally collect anthropometric and anaemia data among girls aged 10-14 years old (Croft et al., 2018), calculating estimates for the age range 15-19 can be used to assess the nutritional status of this population, and to inform policy and nutrition programmes on the best strategy to tackle all forms of malnutrition across the life-course within a country.

For the analyses, adult women and adolescent girls who were pregnant or who had given birth in the two months preceding data collection were excluded, due to weight gain during pregnancy, and following DHS guidelines (Croft et al., 2018). DHS does not collect data on pre-pregnancy BMI status or weight gain during the pregnancy period since its nature is cross-sectional.

Variables for BMI and anaemia among adult women, adolescent girls and children under-5 were generated for this PhD using the available weight, height/length, and haemoglobin data in the DHS datasets. Descriptions of this process are available in the sections below. Individual participants with missing anthropometric measures and data on anaemia status (e.g., missing values or data not recorded), and those with biologically implausible height, weight or haemoglobin values were also excluded from the analytic sample. For WRA, height and weight outside of the ranges 100-220 cm and 20-220 kg, respectively, were set as missing values, as were BMI-for-age z-scores <-5 and >5 for children under-5 (Croft et al., 2018; Williams et al., 2020). Haemoglobin concentrations outside of the 4.0-18.0 g/dL range were considered as biologically implausible values (Sullivan et al., 2008). **Figure 4.4** displays the initial sample and the final analytical sample after exclusions.

Figure 4.4. Flowchart of study participants included in the analyses at the different levels.



4.3.3. Measures and data management

4.3.3.1. Anthropometry measures

Anthropometric data were collected by DHS trained personnel among eligible women and children. A brochure summarising how the DHS team collects anthropometric data is available in their webpage, and it is based on the latest WHO-UNICEF guidelines for anthropometric data collection (The DHS Program, 2019a, 2021; WHO & UNICEF, 2019). Height and weight are measured in children under-5 and WRA using a ShorrBoard® measuring board and a SECA 878® digital scale, respectively. For children younger than 24 months old, recumbent length is obtained; while standing height is measured for older children. If accurate age is not possible to obtain, then length is measured if the child is less than 87cm. Before taking any measurements with the scale, adults are asked to wear light clothing and to remove shoes and any items they may be carrying in their pockets. To weigh children, caregivers are also asked to remove the child's clothing, leaving only undergarments. If this is not culturally appropriate or the climate does not allow, children are wrapped in a blanket, which has been previously weighed. Children who cannot stand on the scale alone are held by their caregiver, and then the weight of the adult is subtracted from the total weight to obtain the child's weight.

The anthropometric data collected is used to calculate the body mass index (BMI) among WRA and indices that reflect the nutritional status of children under-5 (e.g., height-for-age, weight-for-height, and weight-for-age). Although these variables are available in the DHS recode files for every country, these were regenerated following WHO guidelines to ensure consistency throughout all DHS rounds (**Table 4.2**). This process also allowed to measure overweight/obesity among adolescent girls using the latest WHO guidelines (WHO, 2007), by calculating BMI-for-age z-scores, the preferred method, rather than the available standard BMI used for all women (15-49 years old) in the datasets.

For this PhD thesis, BMI was first calculated by dividing body weight (variables *v437* in the IR recodes and *hw2* in the KR recodes) in kilograms by squared height (variables *v438* in the IR recodes and *hw3* in the KR recodes) in squared metres. To define one of the outcomes of interest, overweight/obesity, the Quetelet index was used for adult women (20-49 years old) (WHO, 2020), and the WHO 2007 growth reference data for adolescent girls (15-19 years old) (WHO, 2007). According to this, adult women were categorised as having overweight/obesity if their BMI was ≥25.0 Kg/m^2; whereas among adolescent girls, overweight/obesity was defined as BMI-for-age z-score >1SD above from the median of the reference population. For children under-5 (0-59 months), the WHO 2006 child growth standards, and overweight/obesity was defined as BMI-for-age z-score >2SD (WHO, 2006; Furlong et al., 2016).

Table 4.2. Defining overweight/obesity and anaemia measures for this thesis.

Population	Measure	Definition	Reference
Adult women (20-49 years old)	Overweight/obesity	BMI≥25.0 Kg/m^2	Quetelet index
	Anaemia	Hb <12.0 g/dL	Pullum et al., 2017; Sharma et al., 2019
Adolescent girls (15-19 years old)	Overweight/obesity	BMI-for-age z-score >1SD	WHO 2007 growth reference
	Anaemia	Hb <12.0 g/dL	Pullum et al., 2017; Sharma et al., 2019
Children (0-59 months)*	Overweight/obesity	BMI-for-age z-score >2SD	WHO 2006 growth reference
	Anaemia	Hb <11.0 g/dL	Pullum et al., 2017; Sharma et al., 2019

*Anaemia data only available for the age range 6-59 months among children under-5.

4.3.3.2. Anaemia measures

Diagnosis of anaemia was confirmed by measuring haemoglobin levels by trained DHS staff among eligible women and children (The DHS Program, 2021). The HemoCue® 201+ or the 301+ system, a portable haemoglobin analyser, is used to measure anaemia in blood through a stick capillary blood sample. Eligible participants include WRA and children 6-59 months old. Data from infants younger than 6 months are not collected for presenting higher haemoglobin levels, which may distort the indication of prevalence of anaemia (WHO, 2001; Croft et al., 2018). For women and children aged 12 months or older, capillary blood is obtained from the palm side of the tip of a finger (normally the third or fourth finger); whereas among children <12 months old, the heel is used. A heel puncture is also recommended in undernourished or skinny children to prevent piercing the finger bone. After puncture in the finger or heel, the first two blood drops are wiped away using a sterile gauze, and the third blood drop is collected for anaemia testing. 'Milking' the finger before taking the blood sample collection is contraindicated as it can lower haemoglobin concentrations. Further precautions followed by trained personnel to prevent exposure to blood borne infections (e.g., hepatitis B or HIV) are enclosed in the DHS biomarker manual (The DHS Program, 2021).

The capillary blood samples collected from women and children are used to measure haemoglobin levels and diagnose anaemia. The DHS recode files contain two variables on haemoglobin levels: one without adjustment and another one adjusted for altitude and smoking. Both factors are known to increase haemoglobin concentrations, since oxygen is less available (Pullum et al., 2017; Croft et al., 2018;

Sharma et al., 2019). The formulas used for adjusting haemoglobin levels by altitude is as follows:

$$\textbf{adjust} = -0.032 * alt + 0.022 * alt^2$$
$$\textbf{adjHb} = Hb - adjust \text{ if adjust} > 0$$

where ***adjust*** is the amount of the adjustment, ***alt*** is altitude in 1,000 feet (converted from meters by dividing by 1,000 and multiplying by 3.3), ***adjHb*** is the adjusted haemoglobin level, and ***Hb*** is the measured haemoglobin level in g/dL (Croft et al., 2018). For altitudes below 1,000 metres, no adjustment is made.

The adjustment for women who smoke is made in accordance with the following table (Croft et al., 2018):

Cigarettes Smoked	Adjust Hb (g/dl) concentration by
Less than 10 per day	No adjustment
10-19 per day	-0.3
20-39 per day	-0.5
40 or more per day	-0.7
Unknown quantity or non-cigarettes smoking	-0.3

The recode files for each country also contain a binary variable indicating the diagnosis of anaemia (i.e., yes/no), and a separate one for the degree of anaemia (i.e., mild, moderate, or severe anaemia); however, following the same logic than the one used for anthropometric measures, a binary variable was created for this PhD thesis using the adjusted haemoglobin levels (variables *v456* in the IR recodes and *hw56* in the KR recodes) (**Table 4.2**). Regenerating the anaemia variable following WHO guidelines, in this case, was a necessary step because the DHS had reported incorrect categorisations of haemoglobin levels for non-pregnant women in the earlier survey rounds (Croft et al., 2018). Adjustment for altitude was available for all datasets included, for data among adult women, adolescent girls and children; nevertheless, adjustment for smoking was missing for a few datasets for data among women, since smoking status had not been collected. The guide to DHS statistics states that altitude data should always be obtained and used to adjust haemoglobin levels, but highlights that the adjustment for smoking status is less substantial, and therefore only used when data is available (Croft et al., 2018).

Anaemia in adult women and adolescent girls aged 15-49 years old was defined as haemoglobin concentration levels (adjusted by altitude and smoking) <12.0 g/dL. For children (6-59 months), haemoglobin levels (adjusted by altitude) <11.0g/dL were indicative of anaemia (Pullum et al., 2017; Sharma et al., 2019).

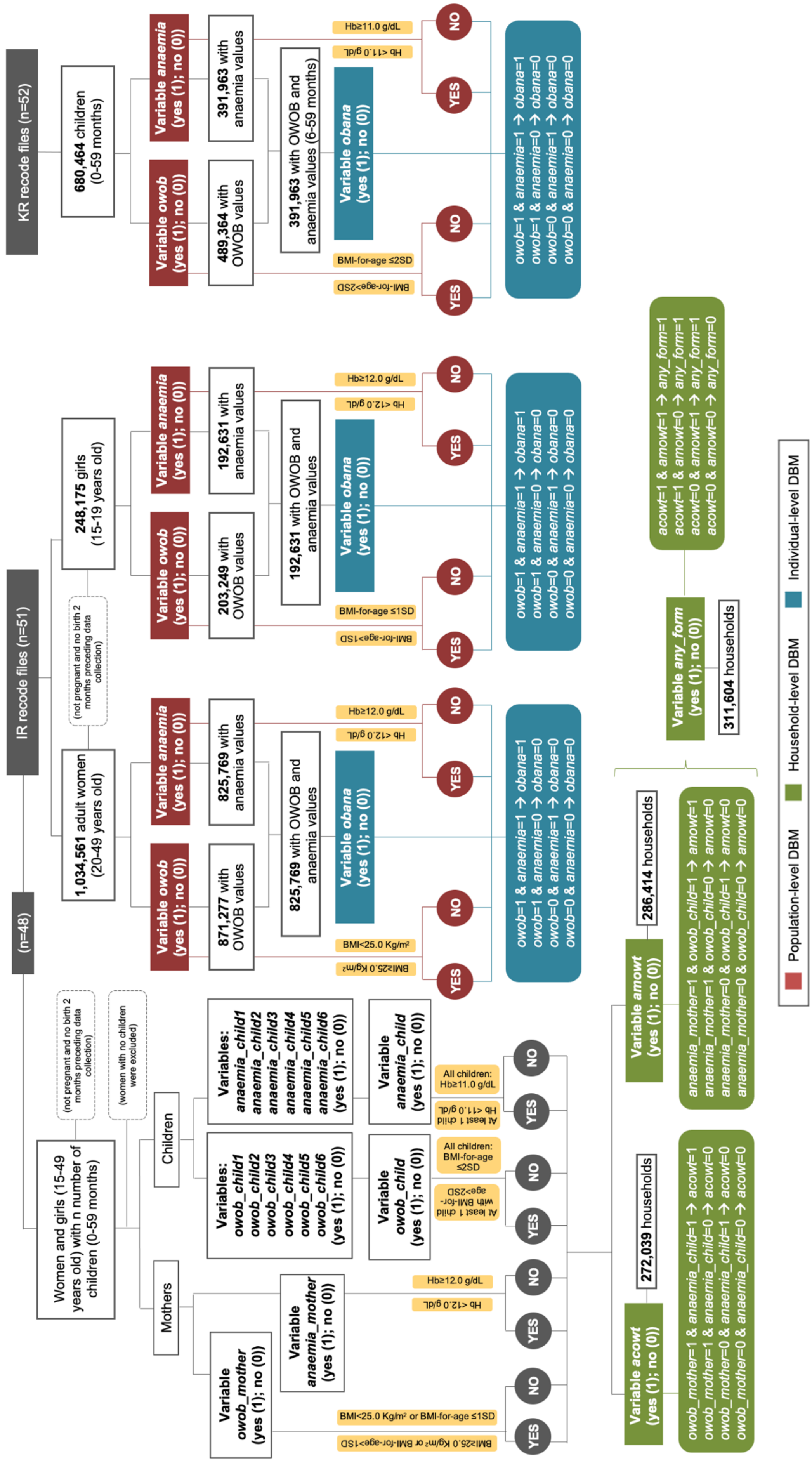
4.3.3.3. Defining the double burden of overweight/obesity and anaemia

Once the variables for overweight/obesity and anaemia were regenerated for the different age groups, then the next step was to define the DBM at the three levels through the creation of binary variables (i.e., yes, has the outcome (1); no, does not have the outcome (0)). Do-files in Stata (n=4) were used for the write-up of the coding for all the analyses as follows: i) population and individual-level DBM among adult women (20-49 years old), ii) population and individual-level DBM among adolescent girls (15-19 years old), iii) population and individual-level DBM among children (0-59 months), and iv) household-level DBM. The do-files were run for each individual country's dataset separately.

In this PhD, the WHO (2017a) definition of the DBM was used to guide the generation of the double burden of overweight/obesity and anaemia variables. The first paper in the Lancet's Series on the DBM, was also utilised to inform this process (Popkin et al., 2020). According to the WHO, the DBM is characterised by the coexistence of undernutrition (e.g., wasting, stunting and micronutrient deficiencies) along with overweight, obesity or diet-related NCDs, within individuals (i.e., simultaneous presence of two or more types of malnutrition, or development of multiple types over a lifetime), households (i.e., multiple members affected by different forms of malnutrition) and populations (i.e., undernutrition and overweight prevalent in the same community, region or nation), and across the life-course (WHO, 2017a). Popkin et al. (2020), measured the DBM at the population level (i.e., under-5 wasting; under-5 stunting; under-5 overweight/obesity; thinness among WRA; and overweight/obesity among WRA), household level (i.e., childhood wasting and maternal overweight/obesity; childhood stunting and maternal overweight/obesity; maternal thinness and childhood overweight/obesity; and total intra-household DBM, defined as any of the three individual forms), and individual level (i.e., concurrent overweight/obesity and stunting among children under-5). **Figure 4.5** is a summary of how the different DBM variables were created and defined for this PhD thesis, using the available overweight/obesity and anaemia data from the DHS surveys.

Firstly, the DBM at the population level was defined as the bivariate prevalence of overweight/obesity and anaemia for each age group and for every country included. The IR recode files (woman is the unit of analysis) were used for adult women and adolescent girls; whereas the KR recode files (children is the unit of analysis) were used for children under-5. Note that, in Chapter 5, for the DBM at the population level, the full dataset was utilised, and therefore, the sample size is larger for every age group, than that of the DBM at the individual level (e.g., there were more women with

Figure 4.5. Simplified summary of how the DBM variables were generated for this PhD thesis.



available anthropometric data than haemoglobin values). Moreover, overweight/ obesity among children was calculated for children 0-59 months old, while anaemia was only available for those aged 6-59 months (as detailed in the previous section of this chapter).

Secondly, the DBM at the individual level was defined as an adult woman (20-49 years old), adolescent girl (15-19 years old) or child (6-59 months) being simultaneously affected by overweight/obesity and anaemia. The analysis at the individual level and population level were conducted at the same time and coded within the same do-files, and thus, the individual level is explained second. Likewise, the IR recode files were used for adult women and adolescent girls; whereas the KR recode files were used for children under-5. The binary variable *obana* was created as follows: 1= woman/girl/child has both, overweight/obesity (*owob*=1) and anaemia (*anaemia*=1), and 0= any of the other possible combinations (**Figure 4.5**).

Thirdly, the DBM at the household level was defined as multiple family members (i.e., mothers aged 15-49 years old living with their children under-5) affected by different forms of malnutrition (i.e., overweight/obesity and anaemia). As such, two main forms of household-level DBM were identified: i) a mother has overweight/obesity and at least one of her children has anaemia, or ii) a mother has anaemia and at least one of her children has overweight/obesity. For this analysis, the IR recode files were used, where each mother represented one household with up to six children under-5. In the IR recode, the data of children are presented in the same row as their mother, in consecutive columns (e.g., column 10= mother's weight; column 11= weight of child#1; column 12= weight of child#2; etc). Data from all children available in the datasets were used, rather than using data from the youngest child only, to avoid underestimating the DBM. In fewer occasions, more than one woman lived in the same household; however, to ease the process of generating the DBM variables at this level, it was assumed that each woman represented one household (i.e., one woman with n children = one household). Women who had no children were excluded from this analysis. Then, the process of generating the variables involved two main steps: 1) identification of households with at least one child living with either anaemia or overweight/obesity, separately, and 2) separate binary variables for the two identified forms of household-level DBM. For the first step, two separate binary variables were generated, including *anaemia_child* (1= at least one child in the household living with anaemia; 0= all children in the household have normal haemoglobin levels) and *owob_child* (1= at least one child in the household living with overweight/obesity; 0= all children in the household have a normal weight or are underweight). The second step involved the creation of the DBM binary variables *acowt* (1= mother has overweight/obesity (*owob_mother*=1) and at least one child has anaemia (*anaemia_child*=1); 0= any other combination) and *amowt* (1= mother has anaemia (*anaemia_mother*=1) and at least one child has overweight/obesity (*owob_child*=1); 0= any other combination). Lastly, the total intra-household DBM was also calculated (variable *any_form*), defined as a household presenting either one of the two identified forms of household-level DBM, or both (1= *acowt*=1 or/and *amowt*=1; 0= *acowt*=0 and *amowt*=0) (**Figure 4.5**).

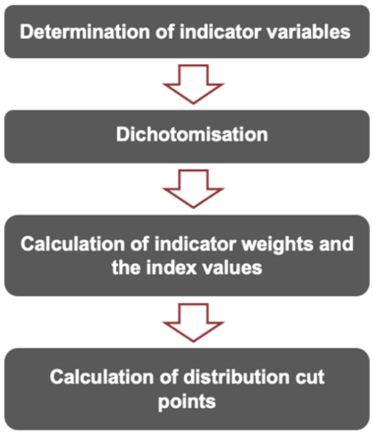
4.3.3.4. Sociodemographic measures

The DHS programme collects information on a wide range of sociodemographic measures, which were used in this PhD thesis to investigate inequalities in the distribution of the double burden of overweight/obesity and anaemia. Reducing inequalities and ensuring that no one is left behind is one of the SDGs (Goal 10) to be achieved by 2030 (UN, n.d.b; UN, 2018). The WHO also promotes the collection and generation of disaggregated data, including “age, gender, ethnicity, race, caste, occupation, education, income and employment” (World Health Assembly, 2009). A guide describing the process of measuring health inequalities has also been developed by the WHO and is available somewhere else (WHO, 2017b). The equity stratifiers available from the DHS data chosen for this PhD thesis included household wealth, education level, area of residence and sex (for children only), which are widely used factors when measuring and understanding nutrition data with an equity lens (da Silva et al., 2018; Flores-Quispe et al., 2019; Jiwani et al., 2019; Development initiatives, 2020; Jiwani et al., 2020; Nguyen et al., 2021).

4.3.3.4.1. Household wealth

DHS measures household wealth as a composite measure of household assets (e.g., bicycles, cars, or radios) and characteristics (e.g., flooring material, drinking water source, or type of toilet facility), following the steps highlighted in **Figure 4.6**. The generation of this variable is described in depth in a DHS manual (Rutstein & Johnson, 2004). First, indicator variables to construct the DHS wealth index are identified, which encompass almost all household assets and utility services, including country-specific items, in order to get a better distribution of households. These data are collected from one household member. Then, to be able to form the index, these variables are broken into sets of dichotomous variables with the underlaying wealth scale. Second, principal component analysis is utilised to assign the indicator weights to produce the household’s index value. Finally, wealth quintiles (i.e., five 20% sections) are created to facilitate tabular analysis using DHS data, which are based on the distribution of the household population rather than on the distribution of households: Q1 (poorest), Q2 (poorer), Q3 (middle), Q4 (richer), Q5 (richest). For the analyses by household wealth enclosed in this PhD thesis, the five wealth quintiles were used, in the available format in the DHS recode files (variable *v190*). The earliest DHS datasets with available anthropometric and anaemia data (i.e., year 2000) used for Chapter 8, had a separate dataset with the wealth index variable (i.e., WI recode files), and therefore, these recode files were merged to the individual recodes before the analysis.

Figure 4.6. Step-by-step construction of the DHS wealth index.



Adapted from *DHS Comparative Reports 6: The DHS Wealth Index* (Rutstein & Johnson, 2004).

4.3.3.4.2. Education level

Education level is assessed in DHS surveys by self-report of the completed educational level. DHS categorises education level into quartiles (variable *v106*): E1 (no education), E2 (primary education), E3 (secondary education), E4 (higher education). For this PhD thesis, the education level variable (or maternal education level for children and at the household level) was used in its current format, although with a few exceptions. Among adolescent girls, the third and fourth education levels were combined into one category to avoid low sample sizes (<25 observations) for the stratified magnitude of DBM at the individual level. Likewise, in Chapter 8 (i.e., trends in the intra-individual DBM among adult women), the third and fourth education levels were also merged for the same reason.

4.3.3.4.3. Area of residence

The participant or household's place of residence is defined in DHS according to country specific definitions, and categorised as urban or rural (variable *v025*). In Chapter 8, area of residence was further categorised into: capital, other urban and rural. This allowed to explore whether trends in concurrent overweight/obesity and anaemia among adult women are occurring at a different pace, not only in urban vs. rural areas, but also in capital cities when compared to other urban areas. "Capital" was defined differently across countries using variable *v024* (region) (**Table 4.3**), and referred to either the capital, largest or economic city. On a few occasions, the capital city was not isolated in a survey, and thus, urban residents living in the region where the capital city is located were classified as "residents of the capital city". In India, two main cities were used as the capital: Mumbai and New Delhi.

Table 4.3. Defining "capital city" used in Chapter 8 of this thesis, for every LMIC.

Country	Capital	Type
AFRICAN REGION		
Benin	Cotonou	largest/economic
Burkina Faso	Ouagadougou	largest/capital
Burundi	Bujumbura	largest/economic
Cameroon	Douala	largest/economic
Congo	Brazzaville	largest/capital
Democratic Republic of the Congo	Kinshasa	largest/capital
Ethiopia	Addis Ababa	largest/capital
Gambia	Banjul	largest/capital
Ghana	Accra	largest/capital
Guinea	Conakry	largest/capital
Lesotho	Maseru	largest/capital
Madagascar	Antananarivo	largest/capital
Malawi	Lilongwe	largest/capital
Mali	Bamako	largest/capital
Niger	Niamey	largest/capital
Rwanda	Kigali	largest/capital
Senegal	Dakar	largest/capital
Sierra Leone	Freetown	largest/capital
Tanzania	Dar es Salaam	largest/economic
Uganda	Kampala	largest/capital
Zimbabwe	Harare	largest/capital
EASTERN MEDITERRANEAN REGION		
Egypt	Cairo	largest/capital
Jordan	Amman	largest/capital

Table 4.3. (continued)

Country	Capital	Type
EUROPEAN REGION		
Albania	Tirana	largest/capital
Armenia	Yerevan	largest/capital
AMERICAS REGION		
Bolivia	La Paz	capital
Haiti	Port-au-Prince	largest/capital
Honduras	Tegucigalpa	largest/capital
Peru	Lima	largest/capital
SOUTHEAST ASIAN REGION		
India	Mumbai and New Delhi	economic/capital
Nepal	Kathmandu	largest/capital
Timor-Leste	Dili	largest/capital
WESTERN PACIFIC REGION		
Cambodia	Phnom Penh	largest/capital

4.3.3.4.4. Sex

Children were categorised as girls or boys, using the variable *b4* in the kids' recode files. This equity stratifier was only used in Chapter 5 of this thesis, to quantify and explore the distribution and inequalities in the intra-individual DBM of overweight/obesity and anaemia among children under-5.

4.3.3.5. Grouping countries according to different classifications

4.3.3.5.1. World Health Organisation regional classification

Countries were classified into regions according to the WHO classification (https://www.who.int/countries) throughout all the results and discussion chapters. The WHO classifies the countries included in this thesis (n=52) into the following six regions:

- African region (AFRO): Angola, Benin, Burkina Faso, Burundi, Cameroon, Congo, Cote d'Ivoire, Democratic Republic of the Congo, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Lesotho, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zimbabwe.

- Eastern Mediterranean region (EMRO): Egypt, Jordan, Yemen.

- European region (EURO): Albania, Armenia, Azerbaijan, Kyrgyz Republic, Moldova, Tajikistan.

- Americas region (PAHO): Bolivia, Guatemala, Guyana, Haiti, Honduras, Peru.
- Southeast Asian region (SEARO): India, Maldives, Myanmar, Nepal, Timor-Leste.
- Western Pacific region (WPRO): Cambodia.

4.3.3.5.2. The World Bank Income classification

In Chapter 8 of this thesis, countries were also classified according to the latest World Bank Income classification (https://datahelpdesk.worldbank.org). Following this classification, countries are classified into low-income, lower middle-income, upper-middle-income and higher-income economies. Each country's gross national income (GNI) per capita in U.S. dollars is calculated using the World Bank Atlas Method (The World Bank, n.d.). For the current 2022 fiscal year, data from the year 2020 was used. According to this, low-income economies are those with a GNI per capita of $1,045 or less; lower middle-income economies are those with a GNI per capita between $1,046 and $4,095; upper-middle-income economies are those with a GNI per capita between $4,096 and $12,695; and high-income economies are those with a GNI per capita of $12,696 or more. In this PhD thesis, only LMICs (n=52) were included, which encompass low-income, lower-middle-income and upper-middle-income economies:

- Low-income countries: Burkina Faso, Burundi, Democratic Republic of the Congo, Ethiopia, Gambia, Guinea, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Togo, Uganda, Yemen.
- Lower-middle-income countries: Angola, Benin, Bolivia, Cambodia, Cameroon, Congo, Cote d'Ivoire, Egypt, Eswatini, Ghana, Haiti, Honduras, India, Lesotho, Myanmar, Nepal, Nigeria, Sao Tome and Principe, Senegal, Tanzania, Tajikistan, Timor-Leste, Zimbabwe.
- Upper-middle-income countries: Albania, Armenia, Azerbaijan, Gabon, Guatemala, Guyana, Jordan, Kyrgyz Republic, Maldives, Moldova, Namibia, Peru, South Africa.

4.3.4. Statistical analyses

All analyses were conducted on Stata version V.16.0 (Statacorp, College Station, Texas, USA). The code was developed using do-files to answer the different research questions, and then ran for all the DHS datasets included, separately. Sampling weights and the Stata's survey estimation procedures ("*svy*" command) were used throughout the analyses to account for the clustering and stratification in the sample design of DHS surveys. **Figure 4.7** displays the specific analyses undertaken within each chapter of this thesis to achieve the proposed overall aim and objectives. Figures included throughout this PhD thesis, were generated by the author using Tableau, DataGraph and Stata. Studies presented in Chapter 5, 6, 7 and 8 were reported according to The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement guidelines (**Appendix A**) (von Elm et al., 2007).

4.3.4.1. The magnitude of the double burden of overweight/obesity and anaemia

Prevalence estimates and 95% CIs of the different forms of DBM highlighted in section 4.3.3.3 of this chapter (i.e., 1) population-level DBM among adult women, 2) population-level DBM among adolescent girls; 3) population-level DBM among children under-5; 4) intra-individual DBM among adult women; 5) intra-individual DBM among adolescent girls; 6) intra-individual DBM among children under-5; 7) maternal overweight/obesity and childhood anaemia; 8) maternal anaemia and childhood overweight/obesity; and 9) total intra-household DBM) were first calculated for every country included in the thesis. The analyses at the population and individual levels were performed concurrently, using different do-files for each age group; whereas the household-level DBM was investigated separately (**Figure 4.7**).

Secondly, meta-analyses were performed (Stata command *"metaprop"*), using a random-effects model, to estimate the pooled prevalence and 95% CIs of each of the nine forms of DBM, overall (i.e., for all LMICs) and by WHO region (i.e., African, Eastern Mediterranean, European, Americas and Southeast Asian) (Barendregt et al., 2013; Nyaga et al., 2014). The regional pooled prevalence for the Western Pacific could not be generated, as it only had one country (Cambodia) with available data; however, this country was included in the calculation of the overall pooled prevalence.

4.3.4.2. Distribution and inequalities of the double burden of overweight/obesity and anaemia

Stratified estimates by sociodemographic measures (i.e., household wealth, (maternal) education level, area of residence, and sex) were calculated for the following forms of DBM: 1) intra-individual DBM among adult women; 2) intra-individual DBM among adolescent girls; 3) intra-individual DBM among children; 4) maternal overweight/obesity and childhood anaemia; and 5) maternal anaemia and childhood overweight/obesity. The specific sociodemographic characteristics included in the stratified analyses for the five different forms of DBM can be observed in **Figure 4.7**. In accordance with DHS guidelines, prevalence estimates for which the sample size of the subgroup was lower than 25 observations were excluded from the tables presented in Chapter 5 to Chapter 8 (Croft et al., 2018). Then, pooled prevalence estimates were also calculated for each subgroup (Stata command *"metaprop"*) using a random-effects model, overall and by WHO region. Only countries with available prevalence estimates for all subgroups were included in the meta-analyses. As a result, for the analysis at the individual level among adolescent girls, the regional pooled prevalence estimates could not be generated for the Eastern Mediterranean (analysis by household wealth and education level) and European (analysis by education level) regions. Likewise, for the analysis at the household level, the regional pooled prevalence estimates are missing for the Eastern Mediterranean and European regions for the two forms of intra-household DBM by maternal education level.

To further understand and display inequalities in the distribution of the DBM at the individual and household level, different measures of inequality and graphs were used in this PhD thesis (**Figure 4.7**). Inequality measures can be divided into two main groups: simple and complex measures (WHO, 2013b). Differences, including strengths and limitations, of both types are discussed in Chapter 7, where results using both inequality measures are enclosed and compared. In this PhD thesis, inequality gaps (i.e., example of simple measure of inequality) and the slope index of inequality (SII) (i.e., example of complex measure of inequality) were calculated. The first one is used in Chapter 5 and Chapter 6, for all sociodemographic measures, and in Chapter 8 for area of residence; whereas the SII was used in Chapter 8 for household wealth and education level. Another complex measure of inequality, the concentration index of inequality (CIX), is introduced in the discussion section of Chapter 7 and utilised in Chapter 8 for household wealth and education level.

Inequality gaps were defined as the absolute difference in percentage points (pp) between the intra-individual or intra-household DBM prevalence in the two most extreme opposite groups across each socioeconomic measure: richest vs. poorest wealth quintile (%Q5 - %Q1), highest vs. lowest (maternal) education level ((%E4 or %E3) -%E1), urban vs. rural (%Urban - %Rural) and boys vs. girls (%boys - %girls).

A positive gap value depicts a higher prevalence of DBM in the richest quintile (Q5), highest (maternal) education level (E4 or E3), urban areas and boys; whereas a negative gap value depicts a higher prevalence in the poorest quintile (Q1), lowest (maternal) education level (E1), rural areas and girls. P-values were calculated through chi-squared tests (for area of residence and sex) and tests for trend (for household wealth and education level), to test whether differences observed across the different groups were significant (p-value <0.05), or rather due to chance.

The SII was derived through a logistic regression of DBM prevalence as the outcome and household wealth or education level as the independent variable (Stata command *"siilogit"*), providing with the absolute difference in pp between the fitted values of the top and the bottom of the wealth and education distribution (Barros & Victora, 2013; International Center for Equity in Health, n.d.). Positive values indicate that the prevalence of DBM at the top of the socioeconomic indicator is n pp higher than at the bottom; whereas negative values depict the opposite (i.e., higher at the bottom than at the top of the socioeconomic indicator). P-values <0.05 mean that differences observed across groups in DBM prevalence are significant.

The CIX was calculated in its relative formulation with the Stata command "*cixr*", and indicates the extent to which the DBM is concentrated among the disadvantaged or the advantaged (Barros & Victora, 2013; Restrepo-Méndez, 2015; International Center for Equity in Health, n.d.). The CIX uses an analogous approach to the Gini index, by ranking individuals according to socioeconomic position (i.e., wealth quintiles or education levels) on the x-axis and cumulative health condition (i.e., concurrent overweight/obesity and anaemia) on the y-axis. It is expressed on a scale ranging from -100 to 100, where positive values indicate that the richest and most educated have a greater DBM prevalence than the poorest and least educated groups, whereas negative values depict the opposite. A value of 0 represents perfect equality (e.g., if every wealth quintile had 20% of all the DBM prevalence). P-values <0.05 mean that differences observed across groups in DBM prevalence are significant.

Figures to display inequalities in the distribution of the DBM included equiplots and bar graphs. All were created using the software DataGraph (https://www.visualdatatools.com/DataGraph/) for Chapter 5, Chapter 6 and Chapter 8, or the Equiplot Creator Tool (https://www.equidade.org/equiplot_creator) for Chapter 7.

4.3.4.3. Trends in the magnitude and inequalities of the double burden of overweight/obesity and anaemia among adult women

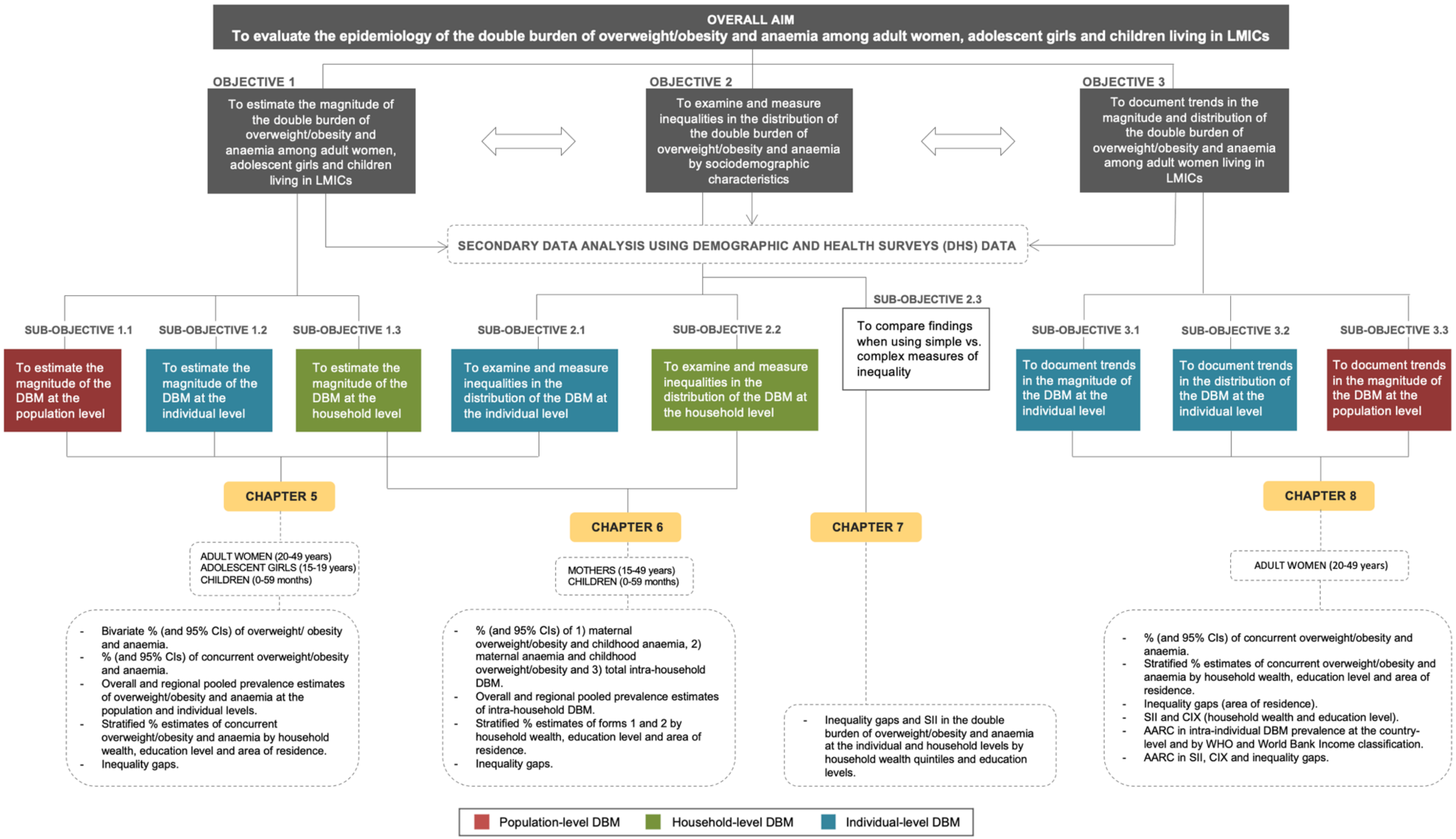
Trends in the magnitude of the intra-individual DBM prevalence among adult women were assessed for every country, through ordinary least square regression models (i.e., DBM prevalence regressed on survey year) to estimate the average annual rate of change (AARC) in pp. All countries with at least two datasets with available anthropometric and anaemia data were included to this analysis (n= 95 datasets across 33 LMICs). To assess trends over time across all LMICs, and by WHO region and World Bank Income classification, the AARC in intra-individual DBM prevalence was computed as the slope of the multilevel linear regressions of outcome prevalence on survey year (Stata command *"mixed"*), with survey time point as the first level and country as the second level (Jiwani et al., 2020). The same process was performed for the DBM at the population level (i.e., bivariate prevalence of overweight/obesity and anaemia), using the same sample size as that utilised to calculate the intra-individual DBM.

Separate multilevel linear regressions of the primary outcome prevalence (i.e., concurrent overweight/obesity and anaemia) were also ran separately for each household wealth, education level and area of residence subgroup. A positive AARC value depicts an increase in pp in concurrent overweight/obesity and anaemia over time, whereas a negative value means that the prevalence of DBM is decreasing. Additionally, for the African region, separate AARC values are presented by subregion (i.e., Eastern and Southern Africa (ESA), and Western and Central Africa (WCA)).

To further investigate country-level changes in the prevalence of concurrent overweight/obesity and anaemia over time, trends in inequalities in the DBM were also documented. Annual changes in SII and CIX (for inequalities by household wealth and education level) and gap (for inequalities by area of residence) were derived from ordinary least square regression models, in a similar manner to the estimation of trends in DBM prevalence for each LMIC. Positive AARC values indicate that inequalities are widening over time; whereas negative values depict that inequalities are narrowing. Furthermore, trends in absolute (SII) and relative (CIX) inequality for household wealth and education level were compared.

Figures to show trends in the magnitude and inequalities of the intra-individual DBM included were created using Stata and DataGraph.

Figure 4.7. Diagram summarising the overall PhD aim, objectives and method suggested to achieve the proposed objectives.



4.4. Chapter summary

In this chapter, the methods employed to achieve the aim and objectives of the PhD thesis are presented. The data source, the DHS, is described and the statistical analyses performed are disclosed. A detailed explanation of how the outcome measures (i.e., the DBM at the three levels) were defined, is also presented in this chapter. Figures are provided to facilitate the explanation of some of these processes. In the next chapter, the findings on the magnitude, distribution, and inequalities of the double burden of overweight/obesity and anaemia at the individual level among adult women, adolescent girls and children, are presented and discussed.

CHAPTER 5

The intra-individual double burden of overweight/ obesity and anaemia: magnitude, distribution, and inequalities

5.1. Chapter overview

This chapter provides the results and discussion of the magnitude, distribution, and inequalities of the intra-individual DBM. Population-level estimates of the DBM (i.e., separate estimates of overweight/obesity and anaemia) are also included in this chapter. The characteristics of surveys used for the analysis and participants are presented first. The findings are then displayed by age group (i.e., adult women, adolescent girls, and children), followed by a discussion section. In the discussion, the key findings are summarised and compared with the existing literature. The weaknesses and strengths of this study are also discussed.

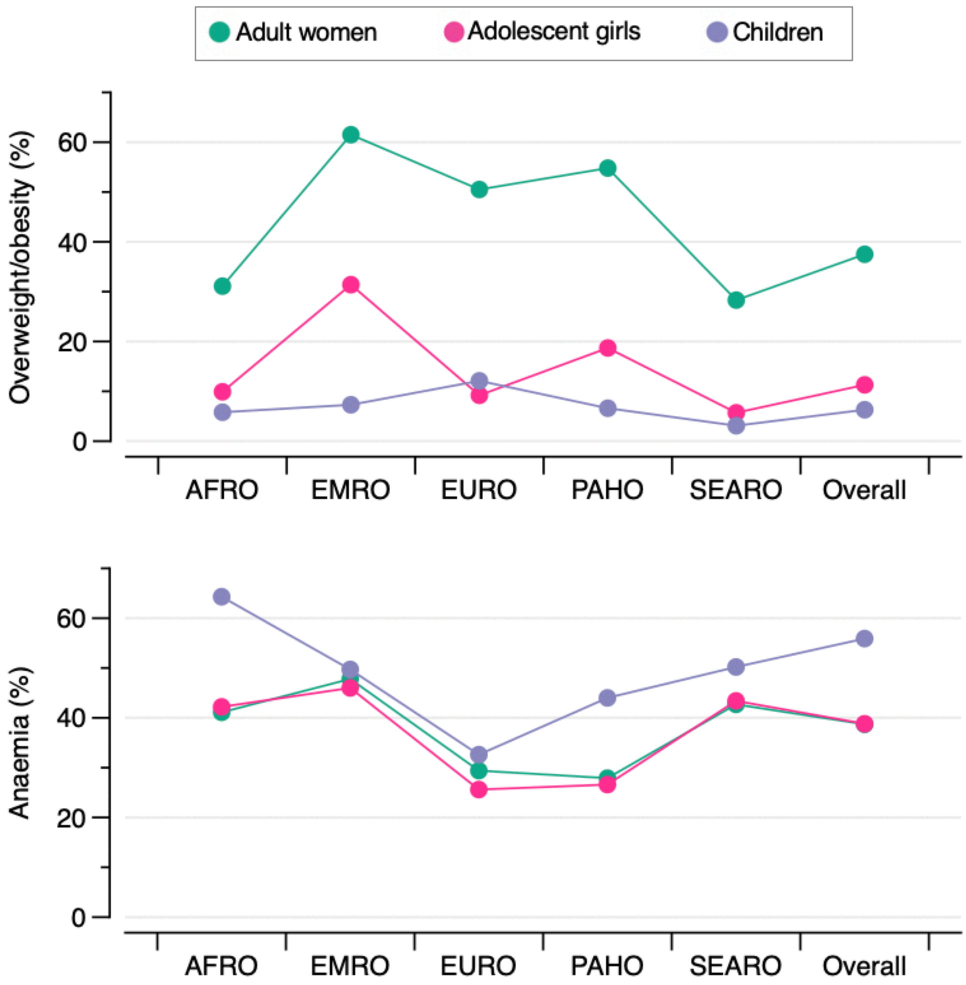
5.2. Results

5.2.1. Characteristics of surveys and participants

Overall, 52 LMICs had a DHS between 2003 and 2018 with available data on anthropometry and anaemia, comprising a total of 825,769 adult women (20-49 years old), 192,631 adolescent girls (15-19 years old) and 391,963 children (6-59 months). By WHO region, per total number of LMICs with a DHS survey from 2000 onwards (n=69), 31 (86.1%) of 36 in the African region, 3 (50.0%) of 6 in the Eastern Mediterranean region, 6 (75.0%) of 8 in the European region, 6 (66.7%) of 9 in the Americas region, 5 (71.4%) of 7 in the Southeast Asian region and 1 (33.3%) of 3 in the Western Pacific region. We found anthropometric and anaemia data missing in Angola for adult women and adolescent girls. For Madagascar and Jordan, height and weight measurements among children were deemed unreliable in the most recent DHS survey and thus, we used the second most recent survey with available data for this age group. As a result, 51 DHS surveys were included in the analysis for adult women and adolescent girls, and 52 DHS surveys for children.

Characteristics of participants included in the study are provided in **Tables 5.1, 5.2** and **5.3**. The median age was between 30 to 43 years old among adult women, 17 to 18 years old among adolescent girls and 28 to 35 months among children. The largest sample size was found in India for the three age groups (n > 100,000); whereas sample sizes were smaller among adolescent girls (n < 1,000 in 16 countries) when compared to adult women or children. The overall bivariate prevalence of overweight/obesity and anaemia was 37.5% and 38.7% among adult women, 11.3% and 38.8% among adolescent girls, and 6.3% and 55.9% among children, respectively (**Figure 5.1** and **Table 5.4, 5.8, 5.12**).

Figure 5.1. Bivariate prevalence of overweight/obesity and anaemia in the studied population by WHO regions and overall.



Note: Each dot is the pooled prevalence of overweight/obesity or anaemia. AFRO: African region; EMRO: Eastern Mediterranean region; EURO: European region; PAHO: Americas region; SEARO: Southeast Asian region. The Western Pacific region is missing as it only has one country with available data (Cambodia).

Table 5.1. Characteristics of adult women (20-49 years old) included in the study.

Adult women (20-49 years old)					
Country and survey year	**Sample size,** *n*	**Age,** *years*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
AFRICAN REGION					
Benin 2017-18	5,274	32.0 [25.0, 39.0]	158.7 [155.0, 162.7]	57.2 [50.5, 66.8]	11.8 [10.7, 12.7]
Burkina Faso 2010	5,671	31.0 [25.0, 39.0]	162.0 [158.0, 165.7]	55.0 [50.0,61.3]	12.1 [10.9, 13.1]
Burundi 2016-17	5,675	30.0 [25.0, 38.0]	155.7 [151.6, 159.8]	50.0 [45.5, 55.5]	12.5 [11.4, 13.4]
Cameroon 2011	5,148	30.0 [24.0, 39.0]	160.3 [156.3, 164.6]	60.3 [53.2, 70.1]	12.4 [11.3, 13.4]
Congo 2011-12	3,779	32.0 [26.0, 39.0]	158.7 [154.5, 162.8]	54.7 [48.7, 63.4]	11.9 [10.9, 12.7]
Cote d'Ivoire 2011-12	3,115	31.0 [25.0, 39.0]	159.0 [154.9, 163.2]	57.0 [51.2, 64.9]	11.9 [10.8, 12.9]
DRC 2013-14	5,930	31.0 [25.0, 39.0]	157.1 [152.3, 161.8]	52.8 [47.3, 59.6]	12.4 [11.3, 13.3]
Eswatini 2006-07	3,102	31.0 [24.0, 39.0]	158.9 [154.8, 163.1]	66.8 [57.8, 78.3]	12.8 [11.7, 13.8]
Ethiopia 2016	9,878	30.0 [25.0, 38.0]	157.4 [153.3, 161.6]	50.6 [45.7, 57.3]	13.0 [11.9, 14.0]
Gabon 2012	3,631	33.0 [25.0, 41.0]	158.9 [154.7, 163.2]	61.3 [53.1, 72.3]	11.7 [10.5, 12.6]
Gambia 2013	2,923	30.0 [24.0, 37.0]	162.2 [157.9, 166.5]	58.1 [51.5, 67.4]	11.5 [10.2, 12.5]
Ghana 2014	3,363	32.0 [25.0, 40.0]	159.4 [155.5, 163.4]	61.2 [53.4, 71.1]	12.3 [11.3, 13.2]
Guinea 2018	3,439	32.0 [25.0, 40.0]	159.2 [155.2, 163.6]	58.1 [51.7, 66.5]	12.2 [11.1, 13.1]
Lesotho 2014	2,383	31.0 [25.0, 39.0]	157.5 [153.8, 161.6]	63.2 [54.7, 74.6]	13.0 [11.9, 14.1]
Madagascar 2008-09	5,585	32.0 [26.0, 40.0]	154.0 [150.0, 158.0]	48.0 [43.9, 53.0]	12.4 [11.5, 13.4]

Values are medians and interquartile ranges, unless otherwise indicated. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.1. (continued)

Adult women (20-49 years old)					
Country and survey year	**Sample size,** *n*	**Age,** *years*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
AFRICAN REGION					
Malawi 2015-16	5,553	30.0 [25.0, 38.0]	156.2 [152.5, 159.9]	54.6 [49.5, 61.7]	12.7 [11.6, 13.6]
Mali 2018	3,375	31.0 [25.0, 38.0]	162.1 [157.8, 166.2]	60.7 [53.5, 71.0]	11.5 [10.4, 12.5]
Mozambique 2011	9,016	31.0 [25.0, 39.0]	156.3 [152.2, 160.4]	54.3 [49.0, 61.9]	11.9 [10.7, 12.9]
Namibia 2013	3,913	36.0 [26.0, 47.0]	161.5 [156.5, 166.0]	62.2 [52.6, 75.0]	13.2 [12.2, 14.1]
Niger 2012	3,303	30.0 [25.0, 38.0]	160.5 [157.0, 164.5]	57.0 [50.5, 64.9]	12.3 [11.2, 13.2]
Nigeria 2018	10,029	32.0 [26.0, 40.0]	158.5 [154.5, 162.4]	57.1 [50.3, 66.8]	11.7 [10.8, 12.7]
Rwanda 2014-15	4,685	31.0 [25.0, 38.0]	157.0 [153.0, 161.3]	55.5 [50.3, 62.2]	13.3 [12.3, 14.1]
STP 2008-09	1,620	32.0 [26.0, 40.0]	159.8 [156.0, 164.0]	60.0 [54.0, 69.0]	12.3 [11.4, 13.2]
Senegal 2010-11	3,614	30.0 [24.0, 38.0]	163.2 [158.7, 167.4]	57.0 [50.5, 65.7]	11.8 [10.7, 12.7]
Sierra Leone 2013	5,271	32.0 [25.0, 39.0]	158.3 [154.2, 162.4]	55.9 [50.4, 62.7]	12.2 [11.1, 13.1]
South Africa 2016	2,284	33.0 [26.0, 41.0]	158.7 [154.2, 162.5]	70.5 [59.7, 83.3]	12.8 [11.6, 13.9]
Tanzania 2015-16	8,871	32.0 [25.0, 40.0]	156.5 [152.5, 160.5]	56.3 [49.8, 65.5]	12.2 [11.1, 13.2]
Togo 2013-14	3,390	32.0 [25.0, 40.0]	159.1 [155.2, 163.0]	58.0 [51.6, 67.3]	12.2 [11.2, 13.2]
Uganda 2016	3,868	30.0 [25.0, 39.0]	159.2 [155.1, 163.4]	56.7 [50.8, 64.2]	12.7 [11.7, 13.7]
Zimbabwe 2015	6,515	31.0 [25.0, 38.0]	160.5 [156.5, 164.8]	62.3 [54.9, 73.2]	12.9 [11.8, 13.9]

Values are medians and interquartile ranges, unless otherwise indicated. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.1. (continued)

Adult women (20-49 years old)					
Country and survey year	**Sample size,** *n*	**Age,** *years*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
EASTERN MEDITERRANEAN REGION					
Egypt 2014	6,077	34.0 [28.0, 41.0]	159.2 [155.9, 162.7]	75.1 [66.6, 85.2]	12.6 [12.0, 13.2]
Jordan 2017-18	5,879	36.0 [29.0, 43.0]	159.2 [155.9, 162.7]	70.2 [62.0, 80.0]	12.1 [11.1, 13.0]
Yemen 2013	4,730	30.0 [24.0, 38.0]	153.9 [150.1, 157.9]	51.8 [44.9, 61.5]	10.8 [9.5, 12.0]
EUROPEAN REGION					
Albania 2017-18	12,360	43.0 [32.0, 52.0]	159.1 [154.9, 163.7]	67.4 [59.3, 77.0]	12.8 [12.1, 13.5]
Armenia 2015-16	4,868	33.0 [27.0, 41.0]	160.3 [156.4, 163.7]	64.5 [56.7, 74.3]	13.4 [12.5, 14.1]
Azerbaijan 2006	6,304	35.0 [27.0, 42.0]	158.7 [154.8, 162.3]	63.7 [55.8, 72.7]	12.4 [11.4, 13.2]
Kyrgyz Republic 2012	5,765	33.0 [26.0, 41.0]	159.7 [155.6, 163.4]	62.3 [54.7, 71.3]	12.6 [11.5, 13.4]
Moldova 2005	5,495	35.0 [27.0, 43.0]	161.2 [157.4, 165.1]	65.0 [57.0, 76.0]	12.7 [11.8, 13.5]
Tajikistan 2017	7,820	32.0 [26.0, 40.0]	158.1 [154.4, 161.8]	60.2 [52.5, 70.2]	12.2 [11.2, 13.0]

Values are medians and interquartile ranges, unless otherwise indicated. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.1. (continued)

Adult women (20-49 years old)					
Country and survey year	**Sample size,** *n*	**Age,** *years*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
AMERICAS REGION					
Bolivia 2008	4,063	32.0 [26.0, 40.0]	151.8 [148.1, 156.0]	59.2 [52.8, 67.5]	12.5 [11.4, 13.4]
Guatemala 2014-15	18,180	32.0 [25.0, 39.0]	149.1 [144.9, 153.5]	58.5 [50.6, 67.6]	13.4 [12.5, 14.2]
Guyana 2009	3,402	34.0 [27.0, 41.0]	156.0 [151.1, 161.1]	62.9 [53.8, 74.2]	12.5 [11.4, 13.3]
Haiti 2016-17	6,587	31.0 [25.0, 39.0]	159.5 [155.4, 163.6]	59.0 [51.8, 69.2]	12.1 [11.0, 13.1]
Honduras 2011-12	15,323	32.0 [25.0, 39.0]	153.0 [148.7, 157.2]	60.9 [52.5, 71.1]	13.3 [12.4, 14.1]
Peru 2012	17,898	34.0 [27.0, 41.0]	151.8 [148.1, 155.6]	60.5 [53.7, 68.4]	13.1 [12.3, 13.9]
SOUTHEAST ASIAN REGION					
India 2015-16	524,796	32.0 [26.0, 40.0]	152.1 [148.4, 156.0]	50.0 [43.8, 57.5]	11.9 [10.8, 12.8]
Maldives 2016-17	5,570	33.0 [27.0, 40.0]	152.2 [148.6, 156.0]	59.6 [52.2, 68.5]	11.7 [10.7, 12.5]
Myanmar 2015-16	10,054	34.0 [27.0, 42.0]	152.7 [149.2, 156.2]	51.8 [45.7, 59.6]	12.1 [11.2, 13.1]
Nepal 2016	4,787	32.0 [25.0, 40.0]	151.6 [148.0, 155.4]	50.1 [44.6, 57.5]	12.3 [11.4, 13.2]
Timor-Leste 2016	2,870	32.0 [25.0, 41.0]	152.0 [148.2, 155.5]	47.6 [42.8, 53.1]	12.9 [12.1, 13.6]
WESTERN PACIFIC REGION					
Cambodia 2014	8,703	32.0 [26.0, 41.0]	153.2 [149.7, 156.7]	51.4 [46.1, 58.2]	12.2 [11.3, 13.0]

Values are medians and interquartile ranges, unless otherwise indicated. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.2. Characteristics of adolescent girls (15-19 years old) included in the study.

Adolescent girls (15-19 years old)					
Country and survey year	**Sample size,** *n*	**Age,** *years*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
AFRICAN REGION					
Benin 2017-18	1,481	17.0 [15.0, 18.0]	157.0 [153.1, 161.1]	50.2 [45.6, 55.2]	11.7 [10.7, 12.6]
Burkina Faso 2010	1,512	17.0 [16.0, 18.0]	159.2 [155.1, 163.0]	51.3 [46.8, 56.7]	12.1 [10.9, 13.0]
Burundi 2016-17	1,891	17.0 [16.0, 18.0]	154.1 [149.9, 158.4]	48.4 [43.6, 53.2]	12.5 [11.6, 13.5]
Cameroon 2011	1,654	17.0 [16.0, 18.0]	158.7 [154.8, 163.0]	54.8 [49.7, 60.8]	12.4 [11.4, 13.3]
Congo 2011-12	959	17.0 [15.0, 18.0]	157.2 [153.1, 161.4]	49.8 [45.4, 54.7]	11.9 [11.0, 12.7]
Cote d'Ivoire 2011-12	843	17.0 [16.0, 18.0]	157.0 [153.5, 161.6]	52.2 [46.8, 57.3]	11.9 [10.9, 12.9]
DRC 2013-14	1,706	17.0 [16.0, 18.0]	155.3 [150.0, 159.5]	49.5 [44.5, 54.6]	12.3 [11.3, 13.3]
Eswatini 2006-07	1,112	17.0 [16.0, 18.0]	158.1 [153.5, 162.2]	56.7 [51.0, 62.5]	12.9 [11.9, 13.7]
Ethiopia 2016	3,006	17.0 [16.0, 18.0]	156.9 [152.8, 161.0]	48.4 [43.6, 53.6]	13.1 [12.1, 14.1]
Gabon 2012	1,036	17.0 [16.0, 18.0]	157.5 [153.3, 161.5]	52.1 [47.1, 58.1]	11.6 [10.5, 12.5]
Gambia 2013	958	17.0 [16.0, 18.0]	160.7 [157.0, 165.0]	51.5 [47.0, 57.7]	11.6 [10.7, 12.6]
Ghana 2014	833	17.0 [16.0, 18.0]	158.4 [154.9, 162.3]	52.8 [48.0, 58.0]	12.0 [11.0, 12.8]
Guinea 2018	1,097	17.0 [15.0, 18.0]	157.2 [152.6, 161.8]	51.9 [47.5, 57.8]	12.1 [11.0, 12.9]
Lesotho 2014	731	17.0 [16.0, 18.0]	156.0 [152.2, 159.6]	52.8 [48.2, 58.9]	13.1 [12.1, 14.0]
Madagascar 2008-09	1,659	17.0 [16.0, 18.0]	151.5 [147.9, 155.6]	45.0 [41.0, 49.0]	12.4 [11.6, 13.4]

Values are medians and interquartile ranges, unless otherwise indicated. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.2. (continued)

Adolescent girls (15-19 years old)					
Country and survey year	**Sample size,** *n*	**Age,** *years*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
AFRICAN REGION					
Malawi 2015-16	1,507	17.0 [16.0, 18.0]	155.4 [151.5, 159.2]	50.9 [46.5, 56.1]	12.5 [11.6, 13.4]
Mali 2018	863	17.0 [16.0, 18.0]	160.5 [156.4, 164.9]	53.7 [48.8, 59.5]	11.4 [10.5, 12.4]
Mozambique 2011	2,594	17.0 [15.0, 18.0]	154.4 [150.2, 158.8]	50.1 [45.4, 55.4]	11.9 [10.8, 12.9]
Namibia 2013	776	17.0 [16.0, 18.0]	159.7 [155.0, 163.9]	50.8 [46.0, 57.3]	13.3 [12.3, 14.1]
Niger 2012	706	17.0 [16.0, 18.0]	158.2 [154.2, 162.0]	49.5 [45.3, 54.5]	12.2 [11.2, 13.2]
Nigeria 2018	2,559	17.0 [15.0, 18.0]	157.0 [152.6, 160.8]	50.0 [45.2, 55.7]	11.6 [10.8, 12.5]
Rwanda 2014-15	1,345	17.0 [16.0, 18.0]	155.3 [151.0, 160.0]	53.0 [47.6, 58.8]	13.2 [12.3, 14.0]
STP 2008-09	430	17.0 [16.0, 18.0]	158.0 [154.0, 162.0]	53.0 [49.0, 60.0]	11.9 [10.9, 12.8]
Senegal 2010-11	1,215	17.0 [16.0, 18.0]	162.0 [157.6, 166.4]	51.2 [46.4, 56.8]	11.9 [10.8, 12.8]
Sierra Leone 2013	1,612	17.0 [15.0, 18.0]	156.4 [152.8, 160.4]	51.0 [47.0, 56.0]	12.0 [11.0, 13.0]
South Africa 2016	488	17.0 [16.0, 18.0]	157.8 [153.6, 161.9]	56.3 [49.9, 63.7]	12.7 [11.5, 13.8]
Tanzania 2015-16	2,591	17.0 [15.0, 18.0]	155.3 [151.2, 159.6]	50.5 [45.6, 56.6]	12.1 [11.2, 13.0]
Togo 2013-14	851	17.0 [16.0, 18.0]	158.1 [153.7, 162.2]	52.6 [47.5, 58.0]	11.9 [10.9, 12.8]
Uganda 2016	1,230	17.0 [16.0, 18.0]	157.3 [153.3, 161.8]	52.1 [47.7, 57.5]	12.6 [11.7, 13.5]
Zimbabwe 2015	1,859	17.0 [16.0, 18.0]	159.0 [154.9, 163.0]	53.9 [48.8, 60.1]	12.9 [11.9, 13.9]

Values are medians and interquartile ranges, unless otherwise indicated. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.2. (continued)

Adolescent girls (15-19 years old)					
Country and survey year	**Sample size,** *n*	**Age,** *years*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
EASTERN MEDITERRANEAN REGION					
Egypt 2014	145	18.0 [17.0, 19.0]	159.1 [155.7, 162.3]	62.8 [58.0, 69.8]	12.6 [12.1, 13.1]
Jordan 2017-18	117	18.0 [17.0, 19.0]	158.1 [154.6, 160.7]	60.5 [54.4, 66.9]	12.2 [11.1, 13.1]
Yemen 2013	1,733	17.0 [16.0, 18.0]	153.0 [149.0, 157.0]	45.5 [40.9, 50.3]	10.9 [9.6, 12.1]
EUROPEAN REGION					
Albania 2017-18	1,594	17.0 [16.0, 18.0]	161.1 [158.0, 165.2]	55.1 [50.5, 60.8]	12.9 [12.1, 13.6]
Armenia 2015-16	677	17.0 [16.0, 18.0]	158.2 [153.2, 161.9]	52.5 [48.4, 58.1]	13.2 [12.3, 14.0]
Azerbaijan 2006	1,375	17.0 [16.0, 18.0]	158.2 [154.2, 161.5]	52.0 [48.2, 57.5]	12.6 [11.9, 13.4]
Kyrgyz Republic 2012	1,487	17.0 [16.0, 18.0]	159.2 [155.0, 163.0]	52.0 [48.0, 57.1]	12.5 [11.7, 13.3]
Moldova 2005	1,330	17.0 [16.0, 18.0]	162.0 [157.7, 166.0]	54.0 [49.6, 59.6]	12.8 [12.0, 13.5]
Tajikistan 2017	1,783	17.0 [16.0, 18.0]	157.3 [153.5, 160.9]	51.5 [46.9, 56.7]	12.4 [11.6, 13.2]

Values are medians and interquartile ranges, unless otherwise indicated. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.2. (continued)

Adolescent girls (15-19 years old)					
Country and survey year	**Sample size,** *n*	**Age,** *years*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
AMERICAS REGION					
Bolivia 2008	1,080	17.0 [16.0, 18.0]	153.5 [149.8, 157.1]	53.4 [48.7, 58.6]	12.5 [11.5, 13.5]
Guatemala 2014-15	5,237	17.0 [16.0, 18.0]	149.5 [145.3, 153.9]	49.8 [45.1, 55.5]	13.5 [12.6, 14.2]
Guyana 2009	854	17.0 [16.0, 18.0]	157.0 [152.2, 161.7]	51.5 [45.5, 59.2]	12.5 [11.5, 13.3]
Haiti 2016-17	2,127	17.0 [16.0, 18.0]	158.7 [154.5, 162.9]	51.7 [47.0, 57.0]	11.9 [10.8, 12.8]
Honduras 2011-12	4,516	17.0 [16.0, 18.0]	153.5 [149.5, 157.5]	51.3 [46.2, 57.7]	13.3 [12.5, 14.1]
Peru 2012	4,163	17.0 [16.0, 18.0]	152.6 [148.9, 156.2]	52.5 [47.7, 57.6]	13.1 [12.3, 13.8]
SOUTHEAST ASIAN REGION					
India 2015-16	116,665	17.0 [16.0, 18.0]	151.4 [147.8, 155.4]	43.9 [39.9, 48.6]	11.9 [10.8, 12.8]
Maldives 2016-17	880	17.0 [16.0, 18.0]	153.8 [150.5, 157.7]	47.2 [41.0, 57.0]	11.7 [10.8, 12.5]
Myanmar 2015-16	1,744	17.0 [16.0, 18.0]	152.2 [148.7, 155.8]	46.3 [42.4, 50.6]	12.1 [11.2, 13.0]
Nepal 2016	1,216	17.0 [16.0, 18.0]	152.3 [148.4, 155.8]	46.0 [42.3, 50.3]	12.1 [11.2, 13.0]
Timor-Leste 2016	1,008	17.0 [16.0, 18.0]	150.8 [147.3, 154.9]	43.1 [39.8, 47.3]	12.8 [12.1, 13.5]
WESTERN PACIFIC REGION					
Cambodia 2014	1,796	17.0 [16.0, 18.0]	153.0 [149.7, 156.6]	46.6 [42.6, 50.7]	12.1 [11.2, 12.8]

Values are medians and interquartile ranges, unless otherwise indicated. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.3. Characteristics of children (6-59 months) included in the study.

Children (6-59 months)						
Country and survey year	**Sample size,** *n*	**Age,** *months*	**Girls*,** *%*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
AFRICAN REGION						
Angola 2015-16	5,319	31.5 [18.3, 44.6]	49.8 (47.8, 51.7)	85.3 [76.5, 94.4]	11.6 [9.4, 13.8]	10.5 [9.6, 11.4]
Benin 2017-18	5,343	30.7 [17.5, 45.1]	49.1 (47.7, 50.6)	85.2 [76.3, 94.4]	11.4 [9.2, 13.7]	10.2 [9.2, 11.1]
Burkina Faso 2010	5,685	31.1 [18.2, 44.8]	49.2 (47.8, 50.6)	85.5 [76.6, 94.5]	11.2 [9.0, 13.6]	9.1 [7.9, 10.2]
Burundi 2016-17	5,334	31.6 [18.1, 46.7]	49.9 (48.4, 51.4)	83.9 [75.2, 91.8]	11.1 [9.0, 13.0]	10.6 [9.5, 11.6]
Cameroon 2011	4,394	29.3 [16.2, 43.7]	51.4 (49.7, 53.0)	84.6 [75.2, 94.1]	11.8 [9.5, 14.3]	10.5 [9.5, 11.5]
Congo 2011-12	3,888	30.9 [17.1, 43.3]	51.2 (48.7, 53.4)	86.4 [76.5, 95.2]	11.7 [9.5, 13.9]	10.5 [9.6, 11.3]
Cote d'Ivoire 2011-12	2,685	30.0 [17.1, 43.0]	52.5 (50.1, 54.8)	85.1 [76.4, 93.6]	11.5 [9.3, 13.8]	9.9 [8.9, 10.9]
DRC 2013-14	6,856	31.2 [17.6, 44.8]	50.5 (49.0, 52.0)	84.6 [76.5, 92.1]	11.3 [9.3, 13.3]	10.4 [9.3, 11.5]
Eswatini 2006-07	1,730	29.1 [16.3, 44.1]	50.5 (48.0, 53.1)	85.3 [75.4, 94.7]	12.4 [10.0, 14.7]	11.2 [10.2, 12.1]
Ethiopia 2016	7,426	31.6 [17.8, 46.4]	48.5 (46.9, 50.1)	85.6 [76.7, 94.4]	11.3 [9.1, 13.3]	10.5 [9.4, 11.6]
Gabon 2012	2,903	29.3 [17.0, 43.5]	49.9 (46.5, 53.2)	86.4 [76.2, 95.7]	12.1 [9.8, 14.5]	10.5 [9.6, 11.3]
Gambia 2013	2,614	30.3 [16.7, 43.9]	47.8 (45.5, 50.0)	85.7 [76.4, 95.6]	11.3 [9.1, 13.4]	9.9 [8.8, 10.9]
Ghana 2014	2,359	30.7 [18.5, 44.2]	47.1 (44.7, 49.5)	86.9 [78.4, 96.2]	11.9 [9.6, 14.2]	10.3 [9.1, 11.2]
Guinea 2018	2,867	33.8 [17.8, 45.4]	48.4 (46.5, 50.4)	87.2 [77.3, 96.1]	11.9 [9.7, 14.1]	10.1 [9.2, 11.0]

*Values for girls are percentages and 95% CIs; estimates account for survey design. All other values are medians and interquartile ranges. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.3. (continued)

	Children (6-59 months)					
Country and survey year	**Sample size,** *n*	**Age,** *months*	**Girls*,** *%*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
AFRICAN REGION						
Lesotho 2014	1,127	29.3 [16.0, 44.1]	53.7 (50.5, 56.8)	84.1 [75.4, 93.4]	11.6 [9.6, 14.0]	10.8 [9.8, 11.8]
Madagascar 2003-04	1,383	29.1 [14.0, 45.1]	52.0 (48.7, 55.2)	83.4 [71.3, 92.9]	10.5 [8.1, 12.8]	10.5 [9.8, 11.2]
Malawi 2015-16	4,533	32.6 [18.7, 45.8]	51.8 (50.1, 53.5)	86.2 [77.5, 94.5]	11.9 [9.8, 14.0]	10.5 [9.5, 11.4]
Mali 2018	3,615	31.1 [18.4, 44.8]	48.8 (46.9, 50.7)	87.2 [77.8, 96.4]	11.6 [9.3, 13.9]	9.7 [8.6, 10.7]
Mozambique 2011	4,152	30.3 [16.8, 44.5]	51.2 (49.3, 53.0)	85.0 [75.1, 93.8]	11.9 [9.4, 14.1]	10.3 [9.3, 11.3]
Namibia 2013	1,488	28.6 [16.2, 42.8]	51.2 (48.6, 53.8)	85.0 [76.1, 95.0]	11.5 [9.3, 13.8]	10.9 [9.9, 11.8]
Niger 2012	3,969	32.0 [18.9, 45.3]	49.8 (48.2, 51.5)	85.2 [76.0, 93.9]	10.8 [8.7, 13.0]	10.0 [9.0, 11.0]
Nigeria 2018	9,884	31.2 [17.9, 45.4]	49.0 (47.8, 50.1)	85.4 [76.5, 95.0]	11.6 [9.2, 13.9]	10.3 [9.2, 11.2]
Rwanda 2014-15	3,165	31.1 [17.7, 43.7]	49.2 (47.3, 51.2)	85.1 [76.0, 93.5]	12.0 [10.0, 14.2]	11.4 [10.5, 12.2]
STP 2008-09	1,301	31.1 [18.9, 43.8]	50.6 (46.7, 54.4)	88.0 [78.0, 97.0]	12.0 [10.0, 14.0]	10.6 [9.8, 11.4]
Senegal 2010-11	2,933	29.6 [16.6, 43.8]	48.4 (46.0, 50.9)	85.5 [75.8, 95.1]	11.3 [9.1, 13.3]	9.8 [8.7, 10.8]
Sierra Leone 2013	3,524	30.9 [17.2, 44.3]	51.1 (49.0, 53.3)	86.0 [76.1, 95.5]	12.0 [9.5, 14.2]	9.8 [8.6, 10.7]
South Africa 2016	781	33.5 [19.2, 46.8]	51.4 (47.1, 55.6)	89.3 [78.2, 97.4]	13.0 [10.8, 15.4]	10.5 [9.4, 11.4]
Tanzania 2015-16	7,885	30.0 [17.4, 44.6]	49.4 (48.2, 50.7)	85.1 [76.2, 94.2]	11.6 [9.4, 13.7]	10.6 [9.7, 11.6]

*Values for girls are percentages and 95% CIs; estimates account for survey design. All other values are medians and interquartile ranges. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.3. (continued)

Children (6-59 months)						
Country and survey year	**Sample size,** *n*	**Age,** *months*	**Girls*,** *%*	**Height,** *cm*	**Weight,** *kg*	**Hb,** *g/dL*
AFRICAN REGION						
Togo 2013-14	2,828	31.0 [17.6, 45.0]	49.9 (47.8, 52.0)	86.1 [77.8, 94.3]	11.6 [9.3, 13.7]	10.1 [9.1, 11.2]
Uganda 2016	3,877	30.9 [18.3, 45.3]	49.8 (48.1, 51.5)	86.5[77.1, 95.5]	12.1 [9.8, 14.4]	10.8 [9.7, 11.7]
Zimbabwe 2015	4,065	32.0 [18.7, 46.1]	50.7 (49.0, 52.4)	87.3 [77.5, 96.5]	12.4 [9.9, 14.7]	11.3 [10.5, 12.1]
EASTERN MEDITERRANEAN REGION						
Egypt 2014	4,166	31.5 [18.5, 45.1]	47.8 (45.9, 49.7)	89.2 [79.3, 98.8]	13.0 [10.3, 15.4]	11.5 [10.8, 12.1]
Jordan 2012	5,408	33.0 [19.7, 46.4]	48.7 (46.7, 50.7)	91.0 [81.1, 99.5]	13.2 [10.9, 15.4]	11.6 [10.7, 12.5]
Yemen 2013	3,433	31.7 [18.0, 45.8]	50.2 (48.1, 52.3)	84.4 [76.0, 92.2]	10.8 [8.9, 12.5]	8.7 [7.4, 9.9]
EUROPEAN REGION						
Albania 2017-18	1,890	32.8 [20.5, 46.3]	48.3 (45.5, 51.1)	90.6 [81.4, 100]	14.0 [11.6, 16.3]	11.5 [10.8, 12.3]
Armenia 2015-16	1,302	33.5 [19.4, 46.8]	47.4 (44.7, 50.1)	92.3 [81.5, 100.8]	13.9 [11.5, 16.3]	12.0 [11.3, 12.9]
Azerbaijan 2006	1,665	32.1 [18.8, 45.6]	47.1 (44.5, 49.8)	86.7 [78.4, 95.7]	12.5 [10.3, 14.8]	11.4 [10.6, 12.1]
Kyrgyz Republic 2012	3,531	30.2 [17.1, 43.9]	48.9 (47.1, 50.7)	87.4 [77.9, 96.1]	12.6 [10.3, 14.9]	11.1 [10.1, 12.0]
Moldova 2005	1,083	29.5 [17.1, 44.0]	48.5 (45.2, 51.8)	89.7 [79.2, 98.5]	12.9 [10.7, 15.2]	11.4 [10.7, 12.1]
Tajikistan 2017	5,199	32.4 [19.5, 45.8]	49.6 (47.7, 51.5)	88.7 [79.4, 97.2]	12.5 [10.2, 14.7]	11.2 [10.3, 12.1]

*Values for girls are percentages and 95% CIs; estimates account for survey design. All other values are medians and interquartile ranges. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 5.3. (continued)

	Children (6-59 months)					
Country and survey year	**Sample size**, *n*	**Age**, *months*	**Girls***, *%*	**Height**, *cm*	**Weight**, *kg*	**Hb**, *g/dL*
AMERICAS REGION						
Bolivia 2008	2,285	31.8 [18.4, 45.4]	48.4 (46.0, 50.8)	87.0 [77.3, 95.2]	12.7 [10.2, 15.0]	10.6 [9.4, 11.6]
Guatemala 2014-15	10,287	32.4 [19.1, 45.8]	48.5 (47.4, 49.6)	85.4 [76.3, 93.4]	11.9 [9.7, 14.0]	11.5 [10.6, 12.3]
Guyana 2009	1,308	30.9 [18.7, 45.4]	50.9 (47.4, 54.3)	87.9 [78.0, 97.2]	12.3 [10.1, 14.7]	11.3 [10.3, 12.1]
Haiti 2016-17	4,881	32.6 [18.5, 46.5]	49.6 (47.8, 51.4)	88.0 [78.5, 97.2]	12.3 [10.0, 14.7]	10.4 [9.4, 11.3]
Honduras 2011-12	8,442	30.9 [18.0, 44.9]	47.7 (46.4, 48.9)	86.5 [77.8, 95.1]	12.1 [10.0, 14.4]	11.6 [10.7, 12.3]
Peru 2012	8,194	33.0 [19.8, 46.2]	48.7 (47.3, 50.2)	88.6 [79.0, 96.7]	12.8 [10.4, 15.1]	11.4 [10.6, 12.2]
SOUTHEAST ASIAN REGION						
India 2015-16	196,301	33.1 [19.4, 46.2]	48.0 (47.7, 48.4)	86.9 [77.5, 95.0]	11.1 [9.1, 13.1]	10.7 [9.7, 11.6]
Maldives 2016-17	1,859	34.6 [20.9, 46.6]	46.8 (43.4, 50.2)	91.0 [80.5, 99.3]	12.1 [10.1, 14.3]	11.0 [10.2, 11.9]
Myanmar 2015-16	3,436	33.0 [19.0, 46.0]	48.6 (46.4, 50.9)	87.0 [78.3, 95.0]	11.5 [9.6, 13.4]	10.8 [9.9, 11.6]
Nepal 2016	2,044	32.7 [19.9, 46.0]	48.1 (45.8, 50.4)	86.1 [77.7, 94.5]	11.2 [9.2, 13.2]	10.9 [9.9, 11.7]
Timor-Leste 2016	1,537	33.7 [20.0, 46.6]	47.9 (45.0, 50.9)	87.0 [76.8, 95.0]	10.9 [9.0, 12.7]	11.2 [10.3, 12.0]
WESTERN PACIFIC REGION						
Cambodia 2014	3,799	31.2 [18.2, 45.6]	49.1 (47.0, 51.2)	86.2 [76.5, 94.4]	11.1 [9.2, 13.0]	10.8 [9.9, 11.6]

*Values for girls are percentages and 95% CIs; estimates account for survey design. All other values are medians and interquartile ranges. Hb, Haemoglobin levels; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

5.2.2. Overweight/obesity and anaemia among adult women

The pooled prevalence of concurrent overweight/obesity and anaemia among adult women was 12.4% (95% CI: 11.1, 13.7; I^2: 99.6%), ranging from 1.7% in Ethiopia to 33.6% in Maldives (**Figure 5.2** and **Table 5.4**). The regional pooled prevalence ranged from 11.1% (95% CI: 9.2, 13.0) in the African region to 23.8% (95% CI: 17.0, 30.7) in the Eastern Mediterranean region. The full distribution of the magnitude of the DBM among adult women by sociodemographic characteristics (i.e., household wealth quintile, education level and area of residence) is presented in **Tables 5.5, 5.6** and **5.7**.

The distribution at the regional level of the magnitude of concurrent overweight/obesity and anaemia among adult women by sociodemographic characteristics (i.e., household wealth quintile, education level and area of residence) can be also observed in **Figure 5.3**. Overall, the highest DBM prevalence was found in the richest quintile (16.5%), third education level (13.6%), and urban women (15.3%). The European region presented a distinct pattern for two of the three socioeconomic measures, with the poorer quintile (13.9%), third education level (16.8%) and rural women (13.3%) bearing the largest burden of DBM.

Figure 5.4 shows the absolute inequality of the prevalence of overweight/obesity and anaemia among adult women by the three socioeconomic measures. Countries showed more or less inequalities regardless of the magnitude of DBM (**Tables 5.5, 5.6** and **5.7**). The largest gaps were observed in Yemen, with a 24.0 pp difference ($p<0.001$) in DBM prevalence by household wealth; and in Niger, with a 19.6 pp difference ($p<0.001$) by education level and 11.9 pp difference ($p<0.001$) by area of residence. Gaps were positive in 86.3% (44/51), 76.1% (35/46) and 92.2% (47/51) of countries by household wealth, education level and area of residence, respectively, indicating higher prevalence of concurrent overweight/obesity and anaemia among the richest quintile than the poorest, the most educated than the least educated and urban than rural residents (**Figure 5.4**). The opposite (i.e. higher prevalence among the poorest than the richest, the more educated than the least educated and rural than urban residents), was only observed in 11.8% (6/51) of countries by household wealth, 23.9% (11/46) of countries by education level and 7.8% (4/51) of countries by area of residence. In one country (Albania), the inequality gap in the prevalence of DBM was 0.0 pp among the richest and the poorest group ($p=0.278$) (**Figure 5.4 A**). Differences observed across groups were significant in 80.4% (41/51) of countries by household wealth and 78.4% (40/51) by area of residence (**Figure 5.4 A** and **C**), and in 60.9% (28/46) of countries by education level (**Figure 5.4 B**).

Table 5.4. Prevalence of overweight/obesity, anaemia, and concurrent overweight/obesity and anaemia among adult women.

	Adult women (20-49 years old)*		
Country and survey year	**OWOB**	**Anaemia**	**DBM**
AFRICAN REGION			
Regional prevalence	**31.1 [26.4, 35.8]**	**41.1 [36.7, 45.5]**	**11.1 [9.2, 13.0]**
Benin 2017-18	31.4 [29.7, 33.1]	55.7 [54.0, 57.4]	15.7 [14.6, 16.9]
Burkina Faso 2010	13.1 [11.9, 14.3]	47.5 [45.7, 49.3]	5.3 [4.7, 6.0]
Burundi 2016-17	8.9 [8.0, 9.9]	39.1 [37.4, 40.8]	2.2 [1.8, 2.6]
Cameroon 2011	37.4 [35.7, 39.1]	37.8 [36.1, 39.5]	13.3 [12.3, 14.4]
Congo 2011-12	31.6 [29.1, 34.2]	53.7 [51.1, 56.2]	15.9 [13.8, 18.1]
Cote d'Ivoire 2011-12	30.1 [27.9, 32.4]	52.1 [49.5, 54.7]	13.8 [12.1, 15.6]
DRC 2013-14	18.5 [16.4, 20.8]	36.9 [34.5, 39.4]	5.7 [4.9, 6.6]
Eswatini 2006-07	59.9 [57.9, 61.8]	29.6 [27.9, 31.3]	16.3 [14.9, 17.8]
Ethiopia 2016	8.9 [7.7, 10.3]	23.6 [21.8, 25.4]	1.7 [1.3, 2.1]
Gabon 2012	51.9 [49.1, 54.6]	60.5 [57.6, 63.3]	30.1 [27.6, 32.8]
Gambia 2013	27.0 [25.1, 29.0]	59.2 [56.3, 62.1]	13.7 [12.2, 15.3]
Ghana 2014	47.2 [44.8, 49.7]	40.7 [38.5, 43.0]	17.0 [15.2, 19.0]
Guinea 2018	32.0 [29.8, 34.3]	44.1 [42.1, 46.2]	12.7 [11.4, 14.1]
Lesotho 2014	51.8 [49.3, 54.2]	27.2 [25.2, 29.3]	12.4 [10.9, 14.1]
Madagascar 2008-09	7.9 [6.9, 8.9]	35.3 [33.6, 37.1]	2.2 [1.8, 2.7]
Malawi 2015-16	24.5 [23.1, 26.0]	30.5 [28.9, 32.1]	6.7 [6.0, 7.6]
Mali 2018	31.7 [29.3, 34.3]	61.8 [59.4, 64.2]	15.8 [14.3, 17.4]
Mozambique 2011	19.3 [18.1, 20.5]	53.4 [51.6, 55.2]	8.4 [7.6, 9.2]
Namibia 2013	37.9 [36.0, 39.9]	20.4 [18.7, 22.2]	6.8 [5.8, 7.9]
Niger 2012	20.4 [18.7, 22.3]	42.2 [39.7, 44.7]	7.7 [6.6, 8.9]

*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
We used the most recent dataset available for each country. Estimates were not calculated or are missing for that country due to i) data not available for one or more age groups (i.e., Angola) or ii) children's anthropometric measures were unreliable in the most recent survey (i.e., Jordan and Madagascar).
DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity; DBM, concurrent overweight/obesity and anaemia.

Table 5.4. (continued)

	Adult women (20-49 years old)*		
Country and survey year	**OWOB**	**Anaemia**	**DBM**
AFRICAN REGION			
Nigeria 2018	33.2 [31.9, 34.5]	56.3 [54.9, 57.6]	16.6 [15.6, 17.7]
Rwanda 2014-15	22.9 [21.6, 24.3]	18.6 [17.2, 20.0]	3.4 [3.0, 4.0]
STP 2008-09	39.1 [36.2, 42.1]	38.9 [35.5, 42.5]	14.5 [11.9, 17.7]
Senegal 2010-11	26.0 [23.6, 28.5]	53.4 [50.9, 55.9]	12.8 [11.1, 14.7]
Sierra Leone 2013	21.6 [19.8, 23.5]	42.0 [39.3, 44.7]	8.4 [7.4, 9.6]
South Africa 2016	69.0 [66.5, 71.3]	32.2 [29.1, 35.6]	20.7 [17.8, 23.9]
Tanzania 2015-16	33.7 [32.0, 35.4]	42.3 [40.6, 43.9]	12.0 [11.1, 12.9]
Togo 2013-14	35.5 [33.6, 37.5]	44.7 [42.6, 46.8]	14.7 [13.3, 16.2]
Uganda 2016	28.0 [26.0, 30.0]	29.5 [27.7, 31.4]	6.4 [5.5, 7.5]
Zimbabwe 2015	41.2 [39.5, 43.0]	26.3 [24.9, 27.7]	9.9 [9.0, 10.9]
EASTERN MEDITERRANEAN REGION			
Regional prevalence	**61.5 [24.8, 98.3]**	**47.8 [19.0, 76.7]**	**23.8 [17.0, 30.7]**
Egypt 2014	85.5 [84.7, 86.2]	25.6 [24.1, 27.2]	21.4 [20.0, 22.8]
Jordan 2017-18	70.0 [68.0, 71.9]	44.7 [42.4, 47.0]	30.9 [29.1, 32.8]
Yemen 2013	29.8 [28.4, 31.3]	70.0 [68.0, 71.9]	18.5 [16.9, 20.1]
EUROPEAN REGION			
Regional prevalence	**50.5 [44.2, 56.7]**	**29.4 [20.6, 38.2]**	**13.1 [9.4, 16.8]**
Albania 2017-18	60.5 [59.1, 61.9]	21.7 [20.5, 22.9]	12.6 [11.8, 13.5]
Armenia 2015-16	49.8 [48.1, 51.5]	12.9 [11.5, 14.5]	5.7 [4.9, 6.7]
Azerbaijan 2006	55.7 [54.1, 57.4]	37.3 [35.6, 39.0]	19.7 [18.2, 21.3]
Kyrgyz Republic 2012	43.7 [41.8, 45.7]	34.7 [32.8, 36.7]	12.5 [11.4, 13.7]
Moldova 2005	49.6 [48.0, 51.2]	28.5 [26.9, 30.1]	13.3 [12.4, 14.3]
Tajikistan 2017	43.4 [41.8, 45.0]	42.3 [40.4, 44.2]	16.5 [15.3, 17.8]

*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

We used the most recent dataset available for each country. Estimates were not calculated or are missing for that country due to i) data not available for one or more age groups (i.e., Angola) or ii) children's anthropometric measures were unreliable in the most recent survey (i.e., Jordan and Madagascar).

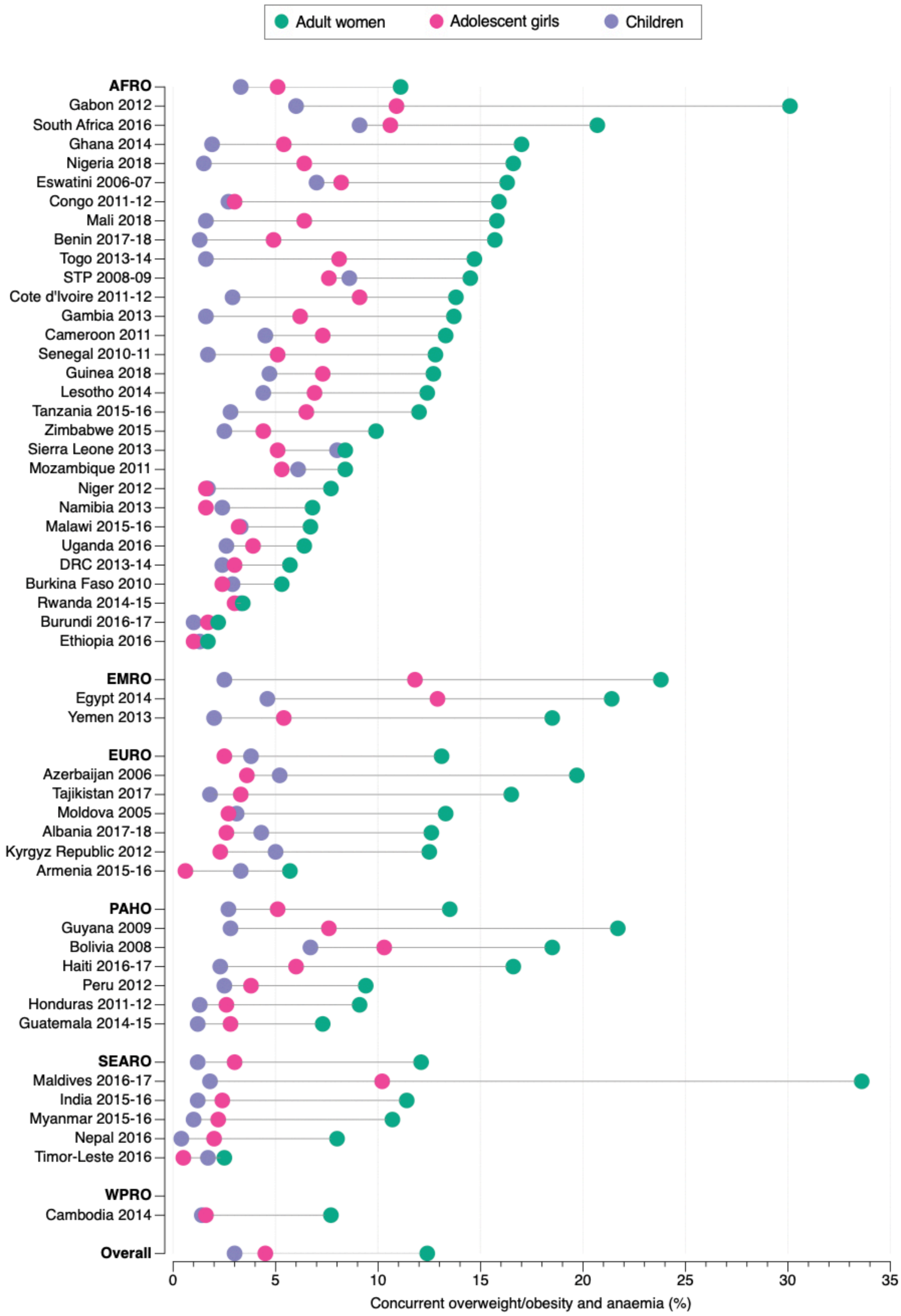
DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity; DBM, concurrent overweight/obesity and anaemia.

Table 5.4. (continued)

	Adult women (20-49 years old)*		
Country and survey year	**OWOB**	**Anaemia**	**DBM**
AMERICAS REGION			
Regional prevalence	**54.8 [48.6, 61.0]**	**27.9 [19.7, 36.0]**	**13.5 [10.5, 16.4]**
Bolivia 2008	56.8 [55.5, 58.1]	36.5 [34.6, 38.5]	18.5 [17.0, 20.1]
Guatemala 2014-15	60.6 [59.6, 61.7]	13.2 [12.5, 13.9]	7.3 [6.8, 7.8]
Guyana 2009	56.1 [53.8, 58.4]	38.4 [36.3, 40.5]	21.7 [19.9, 23.6]
Haiti 2016-17	38.5 [37.0, 40.1]	47.0 [45.3, 48.7]	16.6 [15.3, 17.9]
Honduras 2011-12	59.9 [58.8, 60.9]	15.5 [14.7, 16.2]	9.1 [8.5, 9.7]
Peru 2012	61.7 [60.7, 62.8]	16.8 [16.0, 17.7]	9.4 [8.8, 10.0]
SOUTHEAST ASIAN REGION			
Regional prevalence	**28.3 [19.2, 37.4]**	**42.7 [33.0, 52.4]**	**12.1 [7.2, 17.0]**
India 2015-16	24.3 [24.1, 24.5]	52.9 [52.6, 53.1]	11.4 [11.2, 11.6]
Maldives 2016-17	55.0 [53.0, 57.0]	63.6 [61.5, 65.6]	33.6 [31.7, 35.6]
Myanmar 2015-16	28.2 [27.0, 29.6]	45.7 [44.2, 47.2]	10.7 [9.8, 11.6]
Nepal 2016	26.9 [24.7, 29.1]	39.5 [37.4, 41.8]	8.0 [7.0, 9.2]
Timor-Leste 2016	12.5 [11.4, 13.7]	21.7 [19.8, 23.7]	2.5 [1.9, 3.3]
WESTERN PACIFIC			
Regional prevalence	**-**	**-**	**-**
Cambodia 2014	21.1 [19.9, 22.3]	43.8 [42.4, 45.1]	7.7 [6.9, 8.4]
OVERALL POOLED PREVALENCE	**37.5 [32.0, 43.0]**	**38.7 [34.2, 43.3]**	**12.4 [11.1, 13.7]**

*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
We used the most recent dataset available for each country. Estimates were not calculated or are missing for that country due to i) data not available for one or more age groups (i.e., Angola) or ii) children's anthropometric measures were unreliable in the most recent survey (i.e., Jordan and Madagascar).
DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity; DBM, concurrent overweight/obesity and anaemia.

Figure 5.2. Prevalence of concurrent overweight/obesity and anaemia among adult women, adolescent girls, and children living in LMICs.



Note: AFRO: African region; EMRO: Eastern Mediterranean region; EURO: European region; PAHO: Americas region; SEARO: Southeast Asian region; WPRO: Western Pacific region; DRC: Democratic of the Congo; STP: Sao Tome and Principe. Jordan and Madagascar are missing because data were from different DHS surveys. Angola was not included because data were missing for WRA. The three missing countries were included in the calculation of the regional and overall pooled prevalence.

Table 5.5. Concurrent overweight/obesity and anaemia by household wealth quintiles among adult women (20-49 years old).

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
Regional prevalence	**5.9 [4.8, 7.0]**	**7.9 [6.4, 9.3]**	**10.4 [8.4, 12.3]**	**13.1 [10.7, 15.5]**	**16.8 [14.0, 19.6]**	**10.9**	-
Benin 2017-18	6.4 [4.8, 8.5]	10.0 [8.1, 12.3]	14.0 [11.8, 16.5]	16.8 [14.3, 19.6]	26.6 [23.9, 29.5]	20.2	0.0000
Burkina Faso 2010	2.8 [1.8, 4.2]	2.2 [1.4, 3.5]	3.1 [2.2, 4.5]	4.3 [2.9, 6.2]	12.1 [10.5, 13.7]	9.3	0.0000
Burundi 2016-17	1.0 [0.5, 2.0]	1.5 [0.9, 2.4]	1.5 [0.9, 2.6]	2.4 [1.6, 3.7]	4.3 [3.0, 6.2]	3.3	0.0000
Cameroon 2011	2.7 [1.6, 4.4]	7.9 [6.3, 9.9]	12.8 [10.6, 15.4]	16.2 [13.8, 18.8]	21.2 [18.9, 23.6]	18.5	0.0000
Congo 2011-12	6.2 [5.0, 7.8]	10.0 [7.5, 13.0]	15.5 [11.6, 20.4]	21.0 [16.0, 27.2]	25.3 [20.0, 31.4]	19.1	0.0000
Cote d'Ivoire 2011-12	4.6 [2.8, 7.6]	10.5 [8.0, 13.8]	14.9 [11.0, 19.9]	16.2 [12.8, 20.2]	20.4 [16.5, 24.9]	15.8	0.0000
DRC 2013-14	1.9 [1.3, 2.9]	1.8 [1.1, 3.0]	3.8 [2.7, 5.5]	5.6 [3.6, 8.6]	13.8 [11.6, 16.5]	11.9	0.0000
Eswatini 2006-07	9.7 [7.3, 12.6]	11.9 [9.5, 14.7]	16.2 [13.6, 19.2]	19.0 [16.4, 21.9]	21.2 [17.8, 25.0]	11.5	0.0000
Ethiopia 2016	1.5 [0.9, 2.4]	0.7 [0.3, 1.5]	0.5 [0.2, 1.0]	1.1 [0.7, 2.0]	3.7 [2.8, 4.9]	2.2	0.0000
Gabon 2012	17.3 [14.4, 20.7]	28.3 [23.2, 34.0]	30.5 [25.3, 36.1]	35.5 [30.8, 40.6]	35.0 [28.5, 42.2]	17.7	0.0001
Gambia 2013	11.7 [8.9, 15.3]	8.7 [6.5, 11.5]	15.3 [11.7, 19.7]	17.2 [13.7, 21.4]	14.6 [11.4, 18.6]	2.9	0.0059
Ghana 2014	5.5 [4.0, 7.6]	14.3 [11.4, 17.7]	16.7 [13.6, 20.4]	18.2 [14.5, 22.5]	25.2 [20.8, 30.2]	19.7	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.5. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
Guinea 2018	5.2 [3.8, 7.1]	11.2 [8.7, 14.5]	10.7 [8.2, 13.8]	17.3 [14.1, 21.0]	18.8 [15.8, 22.2]	13.6	0.0000
Lesotho 2014	7.0 [4.6, 10.7]	7.9 [5.4, 11.2]	12.8 [9.6, 16.9]	14.3 [11.0, 18.5]	16.0 [12.7, 19.9]	9.0	0.0008
Madagascar 2008-09	1.0 [0.5, 2.0]	1.0 [0.5, 2.0]	1.2 [0.6, 2.7]	2.4 [1.6, 3.6]	4.6 [3.4, 6.3]	3.6	0.0000
Malawi 2015-16	4.2 [2.9, 5.9]	3.3 [2.3, 4.8]	5.7 [4.3, 7.4]	7.9 [6.1, 10.0]	11.6 [9.5, 13.9]	7.4	0.0000
Mali 2018	11.2 [8.6, 14.5]	13.7 [11.1, 16.9]	16.1 [11.4, 17.3]	19.1 [15.9, 22.7]	19.8 [16.4, 23.7]	8.6	0.0004
Mozambique 2011	3.0 [2.0, 4.4]	3.7 [2.7, 5.0]	5.7 [4.1, 7.8]	8.5 [7.1, 10.1]	18.1 [16.5, 19.7]	15.1	0.0000
Namibia 2013	3.4 [2.0, 5.7]	4.2 [2.7, 6.5]	5.3 [3.6, 7.7]	10.0 [7.6, 13.0]	8.9 [6.5, 12.1]	5.5	0.0001
Niger 2012	4.3 [2.4, 7.6]	5.4 [3.6, 8.0]	5.6 [3.9, 8.2]	6.1 [4.4, 8.5]	16.0 [13.4, 19.1]	11.7	0.0000
Nigeria 2018	5.8 [4.6, 7.4]	10.4 [8.7, 12.3]	15.3 [13.5, 17.3]	21.0 [18.1, 24.4]	25.1 [22.8, 27.5]	19.3	0.0000
Rwanda 2014-15	2.9 [2.0, 4.2]	3.4 [2.3, 4.9]	2.3 [1.5, 3.6]	2.8 [1.9, 4.2]	5.4 [4.2, 6.8]	2.5	0.0032
STP 2008-09	9.3 [6.0, 14.3]	11.2 [7.5, 16.5]	16.0 [10.4, 23.6]	18.4 [13.3, 24.9]	16.7 [11.3, 23.9]	7.4	0.0887
Senegal 2010-11	7.0 [4.9, 9.9]	7.1 [5.4, 9.3]	11.5 [9.0, 14.5]	14.8 [11.5, 18.8]	19.1 [14.9, 24.2]	12.1	0.0000
Sierra Leone 2013	5.9 [4.4, 7.8]	6.2 [4.8, 8.1]	8.0 [6.3, 10.2]	9.8 [7.9, 12.1]	11.6 [8.9, 15.0]	5.7	0.0004

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.5. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
South Africa 2016	16.2 [12.0, 21.5]	22.4 [16.7, 29.3]	20.3 [15.7, 26.0]	23.2 [18.3, 29.0]	22.4 [15.9, 30.5]	6.2	0.3570
Tanzania 2015-16	5.5 [4.0, 7.6]	6.2 [5.0, 7.7]	8.1 [6.6, 9.7]	12.8 [10.9, 14.9]	21.5 [19.6, 23.5]	16.0	0.0000
Togo 2013-14	4.6 [3.0, 6.9]	7.3 [5.2, 10.0]	12.6 [10.1, 15.6]	18.4 [15.3, 21.9]	23.9 [21.0, 26.9]	19.3	0.0000
Uganda 2016	3.2 [1.9, 5.1]	3.5 [2.3, 5.4]	5.3 [3.9, 7.3]	5.8 [4.1, 8.3]	11.5 [9.3, 14.1]	8.3	0.0000
Zimbabwe 2015	5.0 [3.6, 6.8]	5.9 [4.5, 7.6]	10.0 [8.0, 12.3]	11.5 [9.6, 13.6]	14.3 [12.5, 16.2]	9.3	0.0000
EASTERN MEDITERRANEAN REGION							
Regional prevalence	**19.9 [4.2, 35.7]**	**21.8 [11.6, 31.9]**	**22.8 [15.7, 29.8]**	**25.2 [17.6, 32.8]**	**28.0 [19.0, 36.9]**	**8.1**	-
Egypt 2014	23.5 [20.6, 26.7]	21.8 [18.8, 25.1]	20.2 [17.7, 23.0]	18.9 [16.4, 21.8]	23.0 [20.1, 26.3]	-0.5	0.1463
Jordan 2017-18	34.9 [31.4, 38.5]	32.4 [28.4, 36.7]	27.1 [23.4, 31.0]	29.4 [25.1, 34.0]	31.2 [27.3, 35.4]	-3.7	0.0764
Yemen 2013	6.0 [4.2, 8.5]	10.9 [8.6, 13.6]	17.6 [14.7, 20.8]	23.4 [20.4, 26.6]	30.0 [26.1, 34.3]	24.0	0.0000
EUROPEAN REGION							
Regional prevalence	**12.8 [9.0, 16.6]**	**13.9 [10.2, 17.6]**	**13.5 [10.1, 16.9]**	**13.8 [9.6, 18.1]**	**11.8 [7.4, 16.3]**	**-1.0**	-
Albania 2017-18	11.5 [10.2, 13.0]	13.6 [12.2, 15.2]	13.3 [11.8, 15.0]	13.2 [11.3, 15.4]	11.5 [9.5, 13.9]	0.0	0.2784

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.5. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
Armenia 2015-16	4.8 [3.6, 6.4]	6.3 [4.6, 8.5]	6.3 [4.6, 8.6]	6.3 [4.6, 8.5]	4.7 [3.2, 7.1]	-0.1	0.4547
Azerbaijan 2006	17.0 [14.9, 19.3]	19.1 [16.7, 21.8]	19.2 [16.9, 21.7]	22.5 [18.6, 26.9]	20.4 [17.5, 23.7]	3.4	0.1973
Kyrgyz Republic 2012	15.8 [12.9, 19.2]	13.1 [11.0, 15.5]	14.2 [11.8, 17.0]	13.5 [11.4, 15.8]	8.1 [6.3, 10.3]	-7.7	0.0000
Moldova 2005	13.9 [11.5, 16.7]	16.2 [13.6, 19.3]	15.3 [13.2, 17.6]	13.2 [11.8, 14.9]	9.2 [7.8, 10.7]	-4.7	0.0001
Tajikistan 2017	14.4 [12.2, 17.1]	15.8 [13.6, 18.2]	15.0 [12.7, 17.6]	19.9 [17.0, 23.1]	17.1 [15.2, 19.2]	2.7	0.0156
AMERICAS REGION							
Regional prevalence	**9.7 [7.2, 12.2]**	**11.9 [9.0, 14.8]**	**13.8 [10.7, 16.9]**	**15.5 [11.8, 19.1]**	**15.5 [11.3, 19.6]**	**5.8**	**-**
Bolivia 2008	16.3 [13.0, 20.3]	19.6 [16.1, 23.6]	22.8 [19.4, 26.7]	19.4 [16.2, 23.1]	14.5 [12.3, 16.9]	-1.8	0.0044
Guatemala 2014-15	6.4 [5.5, 7.5]	6.9 [5.9, 8.0]	7.3 [6.4, 8.3]	7.9 [7.0, 9.0]	7.5 [6.5, 8.7]	1.1	0.2658
Guyana 2009	19.1 [14.9, 24.1]	21.5 [17.7, 25.8]	19.6 [16.4, 23.3]	24.6 [20.8, 29.0]	22.7 [18.9, 27.1]	3.6	0.3033
Haiti 2016-17	8.4 [6.6, 10.7]	9.6 [7.8, 11.8]	14.2 [12.1, 16.5]	19.1 [16.7, 21.8]	24.4 [22.0, 27.0]	16.0	0.0000
Honduras 2011-12	4.7 [4.0, 5.6]	6.5 [5.5, 7.6]	9.0 [7.7, 10.4]	11.2 [10.0, 12.5]	12.0 [10.5, 13.5]	7.3	0.0000
Peru 2012	9.1 [8.0, 10.4]	9.5 [8.4, 10.8]	9.2 [8.1, 10.4]	9.5 [8.4, 10.7]	9.6 [8.1, 11.2]	0.5	0.9793

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*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.5. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION							
Regional prevalence	**7.7 [4.6, 10.9]**	**9.9 [5.4, 14.4]**	**11.4 [6.0, 16.7]**	**14.1 [9.0, 19.3]**	**17.0 [11.4, 22.6]**	**9.3**	**-**
India 2015-16	3.3 [3.2, 3.5]	6.4 [6.2, 6.7]	10.5 [10.2, 10.8]	15.4 [15.0, 15.8]	18.9 [18.4, 19.3]	15.6	0.0000
Maldives 2016-17	29.1 [26.5, 31.9]	30.9 [28.4, 35.6]	31.7 [28.8, 34.8]	40.0 [34.3, 45.8]	36.2 [30.5, 42.3]	7.1	0.0051
Myanmar 2015-16	4.6 [3.6, 6.0]	7.8 [6.5, 9.3]	10.5 [8.9, 12.2]	13.5 [11.5, 15.7]	15.3 [13.4, 17.5]	10.7	0.0000
Nepal 2016	3.2 [2.1, 4.9]	5.3 [4.0, 6.9]	6.0 [4.4, 8.1]	8.6 [6.5, 11.2]	15.2 [12.7, 18.0]	12.0	0.0000
Timor-Leste 2016	0.2 [0.0, 1.1]	0.9 [0.3, 2.7]	1.0 [0.4, 2.5]	4.6 [2.6, 7.8]	4.9 [3.2, 7.4]	4.7	0.0000
WESTERN PACIFIC REGION							
Regional prevalence	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Cambodia 2014	5.2 [4.0, 6.7]	7.9 [6.3, 9.9]	7.6 [6.2, 9.4]	8.6 [7.1, 10.4]	8.6 [7.4, 10.1]	3.4	0.0120
OVERALL POOLED PREVALENCE	**8.2 [7.1, 9.2]**	**10.1 [8.9, 11.2]**	**11.9 [10.5, 13.3]**	**14.2 [12.5, 15.8]**	**16.5 [14.7, 18.3]**	**8.3**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.6. Concurrent overweight/obesity and anaemia by education level among adult women (20-49 years old).

	Education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value**
AFRICAN REGION						
Regional prevalence	**8.0 [6.4, 9.6]**	**11.3 [9.4, 13.1]**	**12.9 [10.7, 15.1]**	**14.0 [11.1, 16.9]**	**6.0**	**-**
Benin 2017-18	13.8 [12.5, 15.3]	22.2 [19.2, 25.5]	15.0 [12.7, 17.7]	23.3 [16.3, 32.2]	9.5	0.0000
Burkina Faso 2010	4.0 [3.4, 4.7]	7.8 [5.9, 10.2]	12.8 [10.2, 15.9]	1.2 [0.1, 9.0]	-2.8	0.0000
Burundi 2016-17	1.3 [0.9, 1.8]	2.2 [1.6, 3.0]	4.2 [2.9, 5.9]	2.5 [0.8, 7.8]	1.2	0.0000
Cameroon 2011	5.8 [4.3, 7.8]	11.4 [10.0, 12.9]	19.6 [17.6, 21.6]	14.8 [11.1, 19.4]	9.0	0.0000
Congo 2011-12	10.4 [5.4, 19.0]	12.3 [9.6, 15.6]	17.1 [14.4, 20.2]	24.5 [15.8, 36.0]	14.1	0.0139
Cote d'Ivoire 2011-12	12.4 [10.3, 14.9]	15.8 [12.6, 19.5]	14.5 [10.6, 19.6]	18.8 [10.4, 31.5]	6.4	0.2228
DRC 2013-14	2.6 [1.5, 4.4]	4.1 [3.2, 5.2]	8.0 [6.6, 9.6]	12.5 [8.6, 17.9]	9.9	0.0000
Eswatini 2006-07	12.8 [9.8, 16.5]	16.5 [14.2, 19.1]	16.6 [14.8, 18.6]	17.7 [14.6, 21.3]	4.9	0.3170
Ethiopia 2016	1.0 [0.7, 1.4]	2.1 [1.3, 3.3]	3.5 [2.0, 6.2]	3.2 [1.5, 6.6]	2.2	0.0009
Gabon 2012	25.6 [15.0, 40.2]	32.8 [28.6, 37.3]	30.1 [27.6, 32.8]	26.9 [18.7, 37.1]	1.3	0.5250
Gambia 2013	13.7 [11.7, 16.0]	13.3 [9.3, 18.6]	12.9 [9.9, 16.7]	17.3 [11.0, 26.1]	3.6	0.7079

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing for Sao Tome and Principe, Albania, Kyrgyz Republic and Moldova due to sample size <25.

Table 5.6. (continued)

	Education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value**
AFRICAN REGION						
Gambia 2013	13.7 [11.7, 16.0]	13.3 [9.3, 18.6]	12.9 [9.9, 16.7]	17.3 [11.0, 26.1]	3.6	0.7079
Ghana 2014	11.3 [9.0, 14.0]	16.2 [12.9, 20.1]	19.1 [16.8, 21.7]	21.2 [14.1, 30.6]	9.9	0.0014
Guinea 2018	12.1 [10.6, 13.7]	14.3 [10.3, 19.5]	16.6 [13.1, 20.8]	10.0 [5.6, 17.1]	-2.1	0.1051
Lesotho 2014	17.2 [4.1, 50.2]	9.7 [7.8, 12.0]	14.1 [11.5, 17.1]	15.8 [11.4, 21.4]	-1.4	0.0702
Madagascar 2008-09	1.7 [1.0, 2.9]	1.6 [1.1, 2.3]	3.8 [2.8, 5.0]	2.2 [0.8, 5.9]	0.5	0.0002
Malawi 2015-16	7.4 [5.3, 10.1]	5.7 [4.8, 6.8]	8.3 [6.5, 10.6]	10.5 [6.0, 17.8]	3.1	0.0384
Mali 2018	15.5 [13.8, 17.3]	18.6 [14.6, 23.3]	14.3 [11.1, 18.2]	20.7 [11.5, 34.6]	5.2	0.3109
Mozambique 2011	5.1 [4.2, 6.1]	8.7 [7.6, 9.9]	14.8 [12.7, 17.1]	16.5 [11.8, 22.6]	11.4	0.0000
Namibia 2013	5.1 [2.6, 10.0]	6.4 [4.6, 8.9]	6.8 [5.6, 8.3]	8.5 [5.3, 13.3]	3.4	0.6115
Niger 2012	6.9 [5.7, 8.2]	12.0 [8.5, 16.6]	11.0 [7.4, 16.1]	26.5 [15.3, 42.0]	19.6	0.0001
Nigeria 2018	10.0 [8.6, 11.5]	18.9 [16.0, 22.1]	19.1 [17.7, 20.7]	23.9 [21.0, 27.1]	13.9	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries Within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing for Sao Tome and Principe, Albania, Kyrgyz Republic and Moldova due to sample size <25.

Table 5.6. (continued)

	Education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value**
AFRICAN REGION						
Rwanda 2014-15	2.2 [1.4, 3.6]	3.4 [2.8, 4.1]	4.2 [3.1, 5.9]	6.2 [3.6, 10.7]	4.0	0.0286
STP 2008-09¶	13.9 [7.8, 23.5]	14.6 [11.2, 18.9]	14.5 [10.8, 19.2]	-	-	-
Senegal 2010-11	11.3 [9.7, 13.1]	16.1 [12.1, 21.1]	14.0 [10.1, 19.0]	14.1 [5.2, 32.9]	2.8	0.1301
Sierra Leone 2013	7.6 [6.5, 8.9]	10.2 [7.7, 13.4]	10.1 [7.5, 13.5]	9.4 [5.1, 16.7]	1.8	0.1746
South Africa 2016	4.8 [1.9, 11.7]	22.6 [15.8, 31.3]	21.2 [18.1, 24.6]	19.2 [13.1, 27.3]	14.4	0.0908
Tanzania 2015-16	9.0 [7.5, 10.9]	11.1 [10.0, 12.3]	16.4 [14.5, 18.6]	27.3 [17.7, 39.7]	18.3	0.0000
Togo 2013-14	11.2 [9.3, 13.4]	16.3 [13.9, 19.1]	16.8 [14.3, 19.8]	17.6 [10.7, 27.6]	6.4	0.0050
Uganda 2016	5.6 [3.5, 8.8]	5.1 [4.1, 6.3]	8.2 [6.1, 10.9]	11.4 [7.7, 16.6]	5.8	0.0013
Zimbabwe 2015	2.3 [0.6, 8.3]	8.4 [7.2, 9.9]	10.1 [8.9, 11.4]	14.3 [11.4, 17.9]	12.0	0.0003
EASTERN MEDITERRANEAN REGION						
Regional prevalence	**21.2 [19.2, 23.2]**	**23.8 [21.3, 26.4]**	**25.1 [24.1, 26.2]**	**25.2 [23.6, 26.8]**	**4.0**	**-**
Egypt 2014	20.2 [17.7, 23.0]	21.5 [17.8, 25.7]	22.1 [20.3, 24.1]	20.8 [17.6, 24.3]	0.6	0.6499

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing for Sao Tome and Principe, Albania, Kyrgyz Republic and Moldova due to sample size <25.

Table 5.6. (continued)

	Education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value**
EASTERN MEDITERRANEAN REGION						
Jordan 2017-18	31.6 [22.4, 42.6]	36.4 [29.5, 43.9]	30.2 [27.7, 32.8]	31.0 [28.0, 34.3]	-0.6	0.4519
Yemen 2013§	-	-	-	-	-	-
EUROPEAN REGION						
Regional prevalence	**14.1 [9.5, 18.8]**	**14.2 [13.4, 15.1]**	**16.8 [14.1, 19.5]**	**12.4 [7.3, 17.5]**	**-1.7**	**-**
Albania 2017-18	14.3 [7.4, 25.6]	14.0 [12.8, 15.3]	14.2 [12.8, 15.8]	7.4 [5.9, 9.3]	-6.9	0.0000
Armenia 2015-16¶	-	6.2 [3.4, 11.1]	6.6 [5.4, 8.2]	5.0 [3.9, 6.4]	-	-
Azerbaijan 2006	18.9 [16.5, 21.5]	19.0 [13.3, 26.4]	20.2 [18.6, 22.0]	16.6 [14.0, 19.6]	-2.3	0.1706
Kyrgyz Republic 2012¶	-	-	13.1 [11.6, 14.8]	11.9 [10.4, 13.6]	-	-
Moldova 2005¶	-	10.5 [0.0, 97.1]	14.6 [13.4, 15.8]	8.9 [7.7, 10.3]	-	-
Tajikistan 2017	13.3 [8.6, 19.9]	16.6 [12.7, 21.6]	17.3 [15.9, 18.8]	13.5 [11.6, 15.7]	0.2	0.0096

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing for Sao Tome and Principe, Albania, Kyrgyz Republic and Moldova due to sample size <25.

Table 5.6. (continued)

	Education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value**
AMERICAS REGION						
Regional prevalence	**10.8 [8.3, 13.2]**	**13.9 [11.0, 16.9]**	**13.8 [10.3, 17.3]**	**11.1 [8.3, 13.8]**	**0.3**	**-**
Bolivia 2008	21.4 [14.8, 29.9]	21.2 [19.0, 23.6]	18.6 [15.8, 21.7]	11.8 [9.6, 14.4]	-9.6	0.0000
Guatemala 2014-15	7.2 [6.3, 8.3]	8.1 [7.4, 8.8]	6.6 [5.8, 7.4]	5.3 [4.1, 6.7]	-1.9	0.0011
Guyana 2009	17.6 [9.4, 30.4]	22.9 [19.3, 27.4]	21.5 [19.4, 23.7]	21.3 [16.2, 27.5]	3.7	0.8157
Haiti 2016-17	12.5 [10.3, 15.1]	16.8 [14.6, 19.1]	18.0 [16.1, 20.0]	16.5 [13.4, 20.1]	4.0	0.0098
Honduras 2011-12	8.6 [6.6, 11.0]	9.0 [8.3, 9.9]	9.0 [8.0, 10.2]	9.6 [7.9, 11.7]	1.0	0.9115
Peru 2012	10.3 [7.9, 13.4]	9.8 [8.1, 10.9]	9.7 [8.8, 10.6]	8.7 [7.7, 9.8]	-1.6	0.3496
SOUTHEAST ASIAN REGION						
Regional prevalence	**10.6 [6.8, 14.4]**	**13.5 [7.6, 19.4]**	**12.0 [6.9, 17.1]**	**12.4 [7.4, 17.4]**	**1.8**	**-**
India 2015-16	8.4 [8.2, 8.6]	11.4 [11.0, 11.8]	13.4 [13.1, 13.7]	12.6 [12.2, 13.1]	4.2	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing for Sao Tome and Principe, Albania, Kyrgyz Republic and Moldova due to sample size <25.

Table 5.6. (continued)

	Education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value**
SOUTHEAST ASIAN REGION						
Maldives 2016-17	43.9 [35.9, 52.2]	40.5 [37.7, 43.3]	30.6 [27.8, 33.5]	28.6 [24.1, 33.5]	-15.3	0.0000
Myanmar 2015-16	8.7 [6.9, 10.9]	10.9 [9.7, 12.2]	10.4 [9.2, 11.8]	12.9 [10.6, 15.6]	4.2	0.0531
Nepal 2016	5.8 [4.6, 7.2]	8.0 [5.9, 10.8]	10.1 [8.2, 12.5]	10.5 [7.9, 14.0]	4.7	0.0009
Timor-Leste 2016	1.2 [0.5, 2.6]	3.2 [1.7, 5.8]	2.8 [1.9, 4.2]	3.3 [1.7, 6.2]	2.1	0.1314
WESTERN PACIFIC REGION						
Regional prevalence	-	-	-	-	-	-
Cambodia 2014	8.9 [7.2, 10.9]	8.7 [7.6, 9.9]	5.6 [4.7, 6.8]	5.2 [3.4, 8.0]	-3.7	0.0003
OVERALL POOLED PREVALENCE	**9.5 [8.3, 10.6]**	**12.6 [11.2, 14.0]**	**13.6 [12.2, 15.0]**	**13.4 [11.8, 14.9]**	**3.9**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing for Sao Tome and Principe, Albania, Kyrgyz Republic and Moldova due to sample size <25.

Table 5.7. Concurrent overweight/obesity and anaemia by area of residence among adult women (20-49 years old).

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Regional prevalence	**14.9 [12.6, 17.3]**	**8.7 [7.2, 10.1]**	**6.2**	**-**
Benin 2017-18	21.2 [19.3, 23.2]	11.6 [10.3, 13.1]	9.6	0.0000
Burkina Faso 2010	11.5 [10.0, 13.2]	3.0 [2.5, 3.7]	8.5	0.0000
Burundi 2016-17	4.1 [2.5, 6.6]	1.9 [1.5, 2.3]	2.2	0.0027
Cameroon 2011	17.2 [15.7, 18.8]	8.5 [7.3, 10.0]	8.7	0.0000
Congo 2011-12	19.6 [16.7, 22.9]	8.2 [7.1, 9.5]	11.4	0.0000
Cote d'Ivoire 2011-12	19.0 [16.0, 22.3]	8.9 [7.3, 10.8]	10.1	0.0000
DRC 2013-14	10.3 [8.7, 12.2]	3.1 [2.3, 4.1]	7.2	0.0000
Eswatini 2006-07	20.3 [17.6, 23.2]	14.8 [13.2, 16.6]	5.5	0.0007
Ethiopia 2016	3.9 [2.9, 5.2]	1.0 [0.7, 1.4]	2.9	0.0000
Gabon 2012	31.2 [28.3, 34.1]	22.7 [18.6, 27.4]	8.5	0.0029
Gambia 2013	15.3 [13.1, 17.8]	11.6 [9.8, 13.6]	3.7	0.0145
Ghana 2014	20.5 [17.8, 23.5]	12.6 [10.6, 15.0]	7.9	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.7. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Guinea 2018	17.1 [14.6, 19.9]	10.3 [8.8, 11.9]	6.8	0.0000
Lesotho 2014	14.2 [11.1, 17.8]	11.4 [9.8, 13.2]	2.8	0.1307
Madagascar 2008-09	4.5 [3.3, 6.0]	1.7 [1.3, 2.3]	2.8	0.0000
Malawi 2015-16	11.5 [9.4, 13.9]	5.7 [4.9, 6.6]	5.8	0.0000
Mali 2018	20.2 [16.9, 24.0]	14.3 [12.7, 16.1]	5.9	0.0018
Mozambique 2011	13.4 [12.1, 14.9]	5.7 [4.8, 6.8]	7.7	0.0000
Namibia 2013	8.3 [6.5, 10.1]	4.9 [3.8, 6.3]	3.4	0.0008
Niger 2012	17.4 [14.7, 20.5]	5.5 [4.4, 6.8]	11.9	0.0000
Nigeria 2018	20.9 [19.1, 22.7]	12.8 [11.8, 13.9]	8.1	0.0000
Rwanda 2014-15	5.6 [4.5, 7.1]	2.9 [2.4, 3.5]	2.7	0.0000
STP 2008-09	16.9 [12.9, 21.7]	10.8 [8.5, 13.7]	6.1	0.0128
Senegal 2010-11	17.6 [14.7, 21.0]	7.9 [6.6, 9.5]	9.7	0.0000
Sierra Leone 2013	11.5 [9.4, 14.1]	6.8 [5.8, 8.0]	4.7	0.0001

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.7. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
South Africa 2016	20.8 [17.4, 24.6]	20.6 [15.6, 26.6]	0.2	0.9470
Tanzania 2015-16	18.2 [16.4, 20.2]	8.5 [7.5, 9.5]	9.7	0.0000
Togo 2013-14	20.9 [18.6, 23.4]	9.3 [7.8, 10.9]	11.6	0.0000
Uganda 2016	9.0 [7.1, 11.4]	5.5 [4.4, 6.7]	3.5	0.0018
Zimbabwe 2015	13.3 [11.7, 15.1]	7.7 [6.6, 8.9]	5.6	0.0000
EASTERN MEDITERRANEAN REGION				
Regional prevalence	**26.5 [18.9, 34.1]**	**23.4 [16.2, 30.6]**	**3.1**	**-**
Egypt 2014	21.9 [19.7, 24.3]	21.1 [19.3, 22.9]	0.8	0.5735
Jordan 2017-18	30.6 [28.6, 32.7]	33.3 [29.6, 37.2]	-2.7	0.2102
Yemen 2013	26.1 [22.9, 29.6]	14.3 [12.7, 16.0]	11.8	0.0000
EUROPEAN REGION				
Regional prevalence	**12.7 [8.6, 16.8]**	**13.3 [9.9, 16.8]**	**-0.6**	**-**
Albania 2017-18	13.1 [11.9, 14.4]	12.0 [10.9, 13.1]	1.1	0.1685

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.7. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
EUROPEAN REGION				
Armenia 2015-16	5.9 [4.7, 7.5]	5.3 [4.2, 6.8]	0.6	0.5192
Azerbaijan 2006	22.0 [19.7, 24.4]	16.7 [15.1, 18.5]	5.3	0.0004
Kyrgyz Republic 2012	9.6 [7.9, 11.6]	14.3 [13.0, 15.9]	-4.7	0.0002
Moldova 2005	10.8 [9.7, 12.0]	15.2 [13.8, 16.7]	-4.4	0.0000
Tajikistan 2017	17.1 [14.4, 18.9]	16.3 [14.7, 17.9]	0.8	0.4937
AMERICAS REGION				
Regional prevalence	**15.1 [11.9, 18.3]**	**12.2 [9.3, 15.1]**	**2.9**	**-**
Bolivia 2008	18.9 [17.1, 20.9]	17.6 [15.1, 20.4]	1.3	0.4470
Guatemala 2014-15	8.0 [7.3, 8.8]	6.6 [6.0, 7.2]	1.4	0.0042
Guyana 2009	24.1 [20.9, 27.5]	20.7 [18.6, 23.1]	3.4	0.0966
Haiti 2016-17	20.5 [18.6, 22.6]	13.0 [11.5, 14.5]	7.5	0.0000
Honduras 2011-12	10.5 [9.7, 11.4]	7.4 [6.7, 8.1]	3.1	0.0000
Peru 2012	9.3 [8.6, 10.0]	9.7 [8.8, 10.8]	-0.4	0.4676

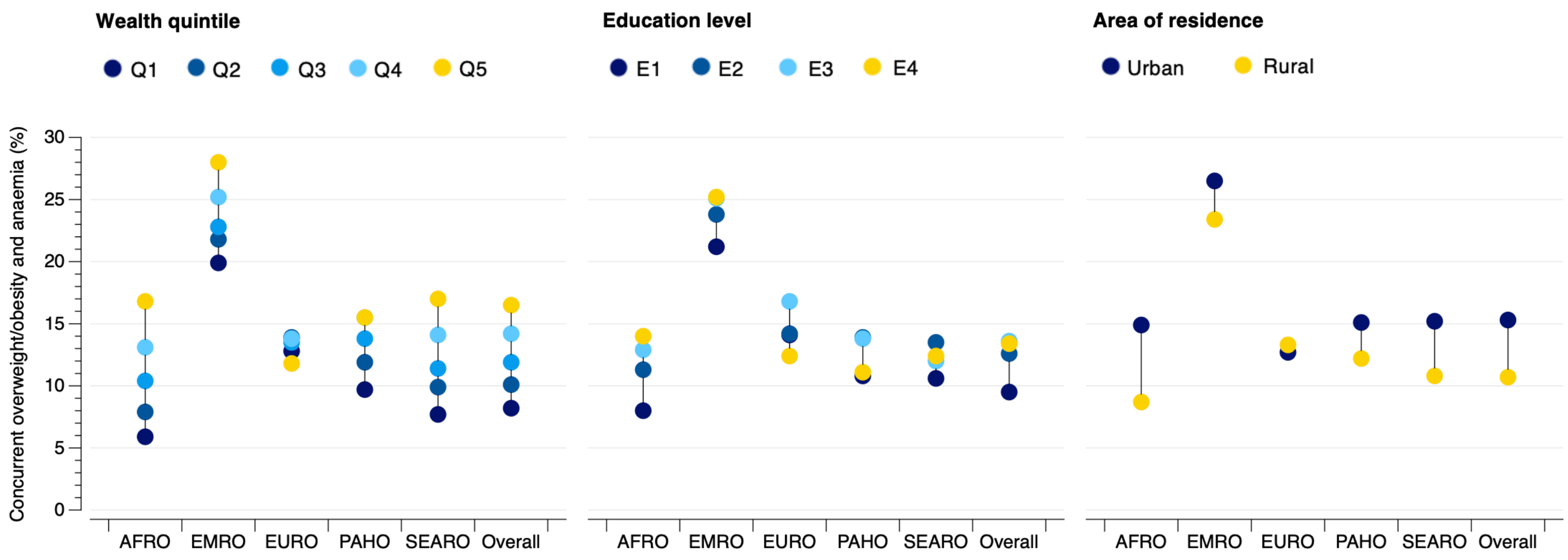
DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.7. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION				
Regional prevalence	**15.2 [9.9, 20.5]**	**10.8 [5.8, 15.8]**	**4.4**	**-**
India 2015-16	16.9 [16.5, 17.3]	8.4 [8.3, 8.5]	8.5	0.0000
Maldives 2016-17	38.6 [34.3, 43.1]	30.2 [28.7, 31.7]	8.4	0.0002
Myanmar 2015-16	14.8 [12.9, 16.9]	9.0 [8.1, 10.0]	5.8	0.0000
Nepal 2016	9.2 [7.8, 10.8]	6.0 [4.8, 7.6]	3.2	0.0031
Timor-Leste 2016	5.0 [3.5, 7.2]	1.3 [0.8, 1.9]	3.7	0.0000
WESTERN PACIFIC REGION				
Regional prevalence	**-**	**-**	**-**	**-**
Cambodia 2014	8.6 [7.4, 9.9]	7.4 [6.6, 8.4]	1.2	0.1435
OVERALL POOLED PREVALENCE	**15.3 [13.8, 16.7]**	**10.7 [9.5, 11.8]**	**4.6**	**-**

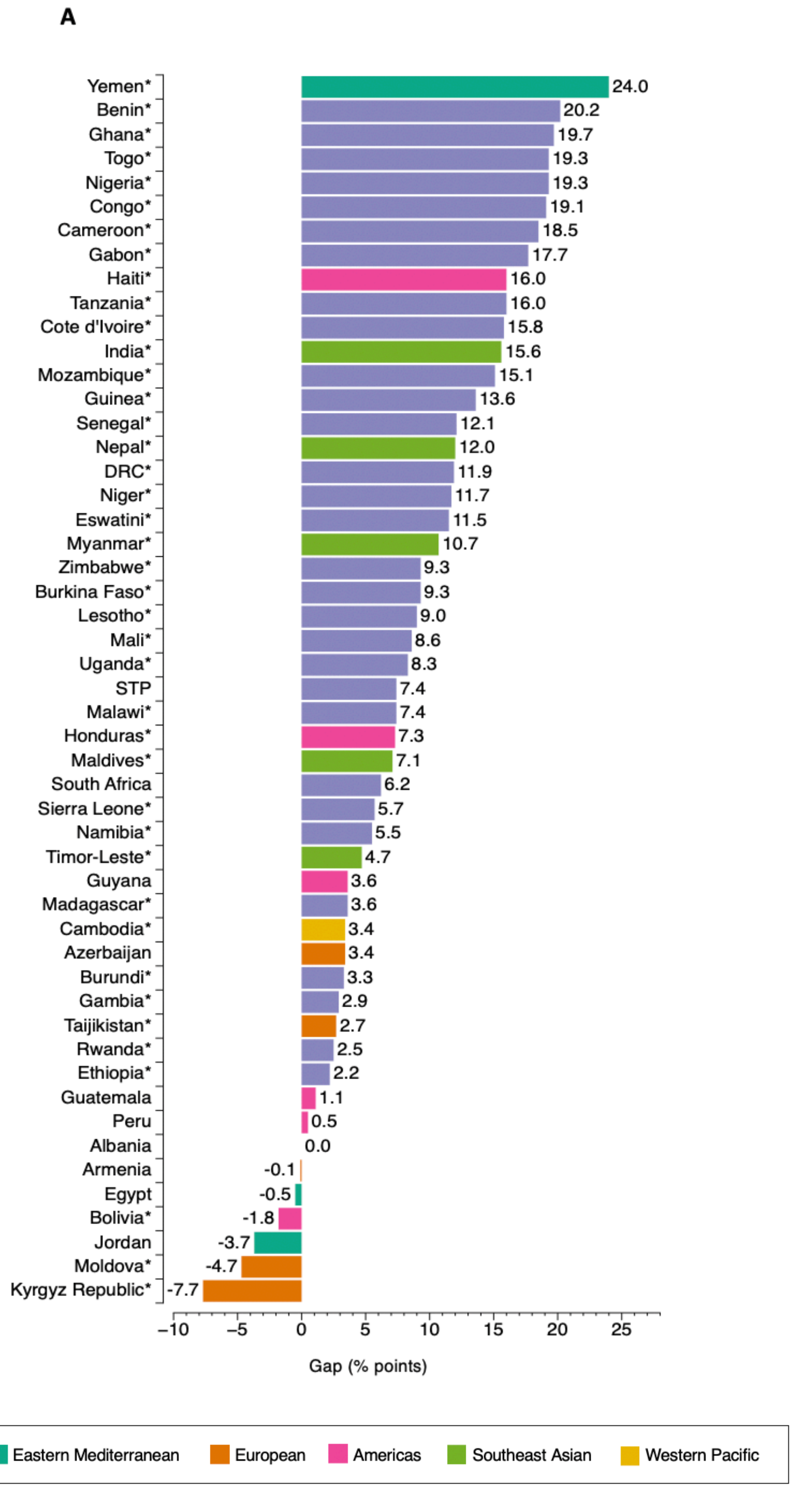
DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Figure 5.3. Distribution of concurrent overweight/obesity and anaemia among adult women by wealth quintile, education level and area of residence across WHO regions and overall.



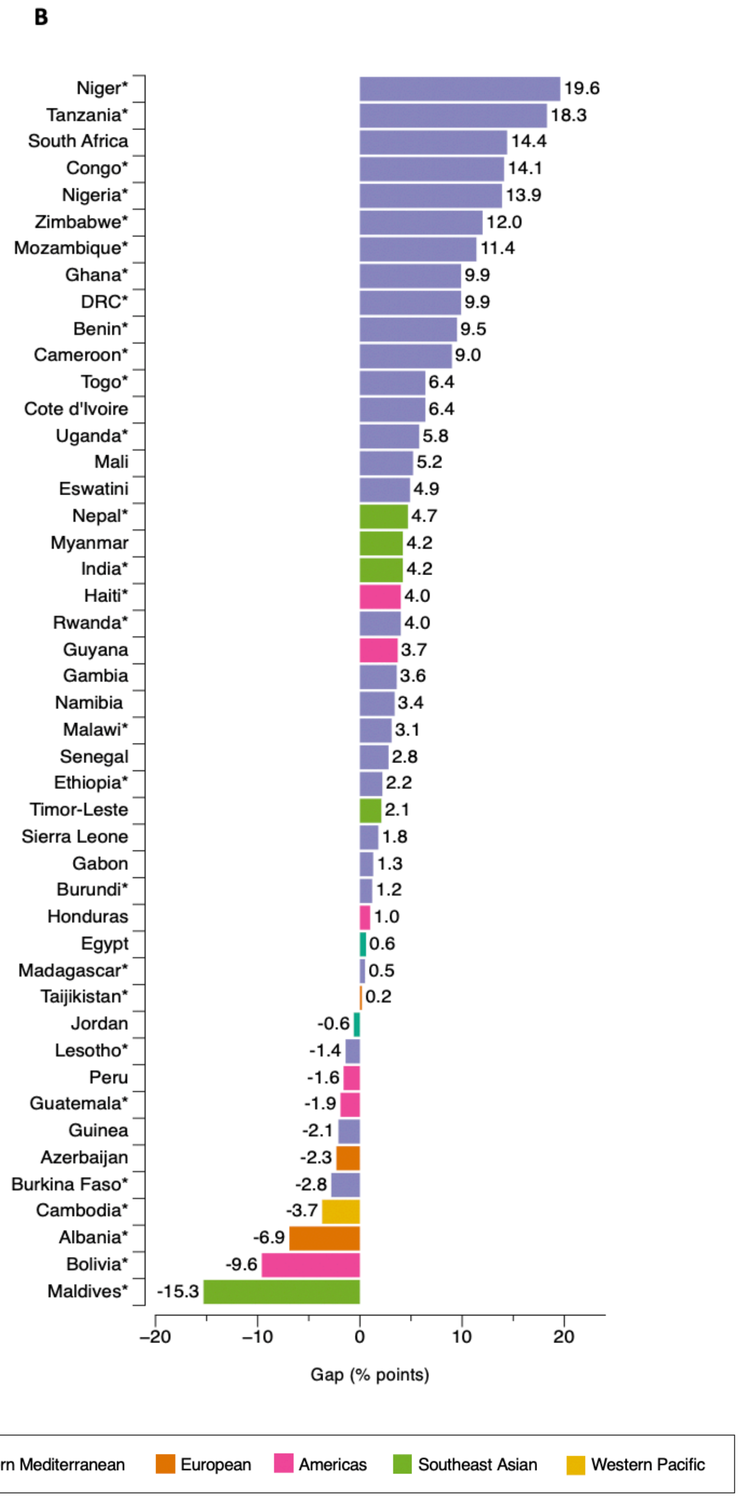
Note: Q1: poorest; Q2: poorer; Q3: middle; Q4: richer; Q5: richest; E1: no education; E2: primary education; E2: secondary education; E3, higher education; AFRO, African region; EMRO, Eastern Mediterranean region; EURO, European region, PAHO, Americas region; SEARO, Southeast Asian region. The WPRO (Western Pacific region) is missing because there was only one country with available data (Cambodia), and thus, the regional pooled prevalence could not be calculated.

Figure 5.4. Absolute gap difference of concurrent overweight/obesity and anaemia by wealth quintile (A), education level (B) and area of residence (C) among adult women.



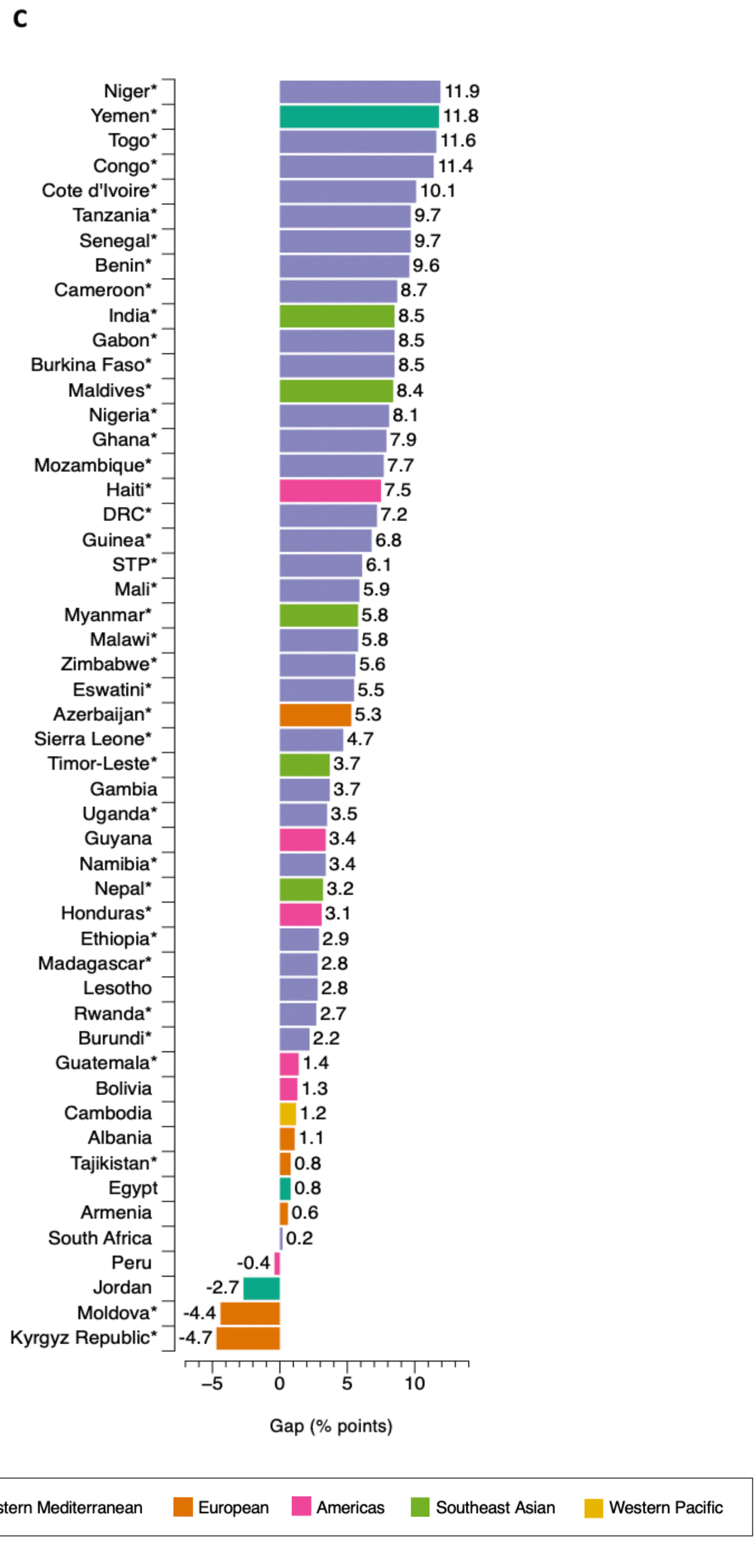
Note: Positive values mean that concurrent overweight/obesity and anaemia is more prevalent in the richest quintile (Q5), highest education level (E4) and in urban areas when compared to the poorest quintile (Q1), lowest education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. In figure B, Yemen was not included because data on education level was missing. Likewise, countries with a sample size <25 observations for E1 or E4 were excluded. DRC: Democratic of the Congo; STP: Sao Tome and Principe.

Figure 5.4. (continued)



Note: Positive values mean that concurrent overweight/obesity and anaemia is more prevalent in the richest quintile (Q5), highest education level (E4) and in urban areas when compared to the poorest quintile (Q1), lowest education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. In figure B, Yemen was not included because data on education level was missing. Likewise, countries with a sample size <25 observations for E1 or E4 were excluded. DRC: Democratic of the Congo; STP: Sao Tome and Principe.

Figure 5.4. (continued)



Note: Positive values mean that concurrent overweight/obesity and anaemia is more prevalent in the richest quintile (Q5), highest education level (E4) and in urban areas when compared to the poorest quintile (Q1), lowest education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. In figure B, Yemen was not included because data on education level was missing. Likewise, countries with a sample size <25 observations for E1 or E4 were excluded. DRC: Democratic of the Congo; STP: Sao Tome and Principe.

5.2.3. Overweight/obesity and anaemia among adolescent girls

The pooled prevalence of concurrent overweight/obesity and anaemia among adolescent girls was 4.5% (95% CI: 4.0, 5.0; I^2: 96.2%), ranging from 0.5% in Madagascar and Timor-Leste to 21.5% in Jordan (**Figure 5.2** and **Table 5.8**). The pooled regional prevalence ranged from 2.5% (95% CI: 1.5, 3.4) in the European region to 11.8% (95% CI: 4.2, 19.3) in the Eastern Mediterranean region. The full distribution of overweight/obesity and anaemia among adolescent girls by sociodemographic characteristics is presented in **Tables 5.9, 5.10** and **5.11**.

Table 5.8. Prevalence of overweight/obesity, anaemia, and concurrent overweight/obesity and anaemia among adolescent girls.

	Adolescent girls (15-19 years old)*		
Country and survey year	**OWOB**	**Anaemia**	**DBM**
AFRICAN REGION			
Regional prevalence	**9.9 [8.2, 11.5]**	**42.2 [37.3, 47.1]**	**5.1 [4.2, 6.0]**
Benin 2017-18	9.4 [7.9, 11.1]	56.6 [53.6, 59.6]	4.9 [3.9, 6.2]
Burkina Faso 2010	6.5 [4.9, 8.5]	45.8 [42.9, 48.7]	2.4 [1.6, 3.5]
Burundi 2016-17	6.2 [4.8, 7.9]	35.4 [32.7, 38.2]	1.7 [1.1, 2.6]
Cameroon 2011	19.8 [17.8, 22.0]	38.2 [35.2, 41.2]	7.3 [6.0, 8.8]
Congo 2011-12	8.4 [6.1, 11.4]	54.3 [48.8, 59.7]	3.0 [1.7, 5.1]
Cote d'Ivoire 2011-12	14.7 [11.9, 18.0]	52.6 [47.7, 57.3]	9.1 [6.7, 12.3]
DRC 2013-14	9.4 [7.5, 11.8]	39.0 [35.5, 42.7]	3.0 [2.1, 4.4]
Eswatini 2006-07	30.3 [27.7, 33.0]	26.4 [23.9, 28.9]	8.2 [6.5, 10.3]
Ethiopia 2016	5.1 [4.0, 6.5]	19.5 [17.4, 21.7]	1.0 [0.6, 1.6]
Gabon 2012	18.0 [14.7, 21.8]	62.6 [58.0, 66.9]	10.9 [8.1, 14.5]
Gambia 2013	11.6 [9.2, 14.4]	57.7 [53.0, 62.2]	6.2 [4.4, 8.6]
Ghana 2014	11.9 [9.6, 14.7]	46.5 [42.6, 50.5]	5.4 [3.9, 7.5]
Guinea 2018	14.7 [12.3, 17.4]	46.6 [43.4, 49.9]	7.3 [5.8, 9.2]
Lesotho 2014	22.5 [18.7, 26.9]	24.1 [19.8, 29.0]	6.9 [4.9, 9.7]

*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

We used the most recent dataset available for each country. Estimates were not calculated or are missing for that country due to i) data not available for one or more age groups (i.e., Angola) or ii) children's anthropometric measures were unreliable in the most recent survey (i.e., Jordan and Madagascar).

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity; DBM, concurrent overweight/obesity and anaemia.

Table 5.8. (continued)

	Adolescent girls (15-19 years old)*		
Country and survey year	**OWOB**	**Anaemia**	**DBM**
AFRICAN REGION			
Madagascar 2008-09	1.6 [1.0, 2.6]	34.6 [31.8, 37.6]	0.5 [0.3, 0.9]
Malawi 2015-16	10.3 [8.5, 12.4]	33.2 [30.3, 36.3]	3.2 [2.3, 4.6]
Mali 2018	13.3 [10.6, 16.5]	64.4 [60.0, 68.6]	6.4 [4.7, 8.7]
Mozambique 2011	1.6 [1.1, 2.3]	55.2 [52.4, 58.0]	5.3 [4.4, 6.4]
Namibia 2013	10.1 [7.8, 13.1]	18.4 [15.5, 21.9]	1.6 [0.8, 3.4]
Niger 2012	5.6 [4.1, 7.7]	43.3 [38.7, 48.0]	1.6 [0.9, 2.8]
Nigeria 2018	10.7 [9.2, 12.4]	59.8 [57.5, 62.1]	6.4 [5.1, 7.9]
Rwanda 2014-15	17.5 [15.5, 19.7]	18.5 [16.3, 21.0]	3.0 [2.2, 4.0]
STP 2008-09	15.7 [12.4, 19.5]	50.2 [43.0, 57.4]	7.6 [5.2, 10.8]
Senegal 2010-11	8.1 [6.1, 10.6]	54.6 [51.2, 58.0]	5.1 [3.4, 7.5]
Sierra Leone 2013	10.7 [9.0, 12.8]	48.0 [44.7, 51.4]	5.1 [3.9, 6.7]
South Africa 2016	32.0 [27.4, 36.9]	33.0 [28.2, 38.2]	10.6 [7.8, 14.1]
Tanzania 2015-16	14.3 [12.5, 16.2]	45.0 [42.6, 47.6]	6.5 [5.2, 8.1]
Togo 2013-14	15.0 [12.4, 18.1]	53.8 [50.0, 57.5]	8.1 [6.1, 10.5]
Uganda 2016	13.7 [11.6, 16.2]	31.5 [28.6, 34.6]	3.9 [2.8, 5.5]
Zimbabwe 2015	16.4 [14.7, 18.3]	25.6 [23.4, 27.9]	4.4 [3.3, 5.7]
EASTERN MEDITERRANEAN REGION			
Regional prevalence	**31.4 [0.0, 64.0]**	**46.0 [10.3, 81.8]**	**11.8 [4.2, 19.3]**
Egypt 2014	54.2 [48.8, 59.6]	22.2 [15.0, 31.6]	12.9 [7.4, 21.7]
Jordan 2017-18	38.8 [27.4, 51.6]	39.6 [28.2, 52.3]	21.5 [12.8, 33.8]
Yemen 2013	8.2 [7.4, 9.3]	68.5 [65.4, 71.4]	5.4 [4.1, 7.0]
EUROPEAN REGION			
Regional prevalence	**9.2 [7.5, 10.8]**	**25.6 [20.1, 31.1]**	**2.5 [1.5, 3.4]**
Albania 2017-18	17.4 [14.9, 20.2]	17.7 [15.3, 20.4]	2.6 [2.3, 5.6]

*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

We used the most recent dataset available for each country. Estimates were not calculated or are missing for that country due to i) data not available for one or more age groups (i.e., Angola) or ii) children's anthropometric measures were unreliable in the most recent survey (i.e., Jordan and Madagascar).

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity; DBM, concurrent overweight/obesity and anaemia.

Table 5.8. (continued)

	Adolescent girls (15-19 years old)*		
Country and survey year	**OWOB**	**Anaemia**	**DBM**
EUROPEAN REGION			
Armenia 2015-16	10.6 [8.2, 13.6]	17.2 [13.9, 21.2]	0.6 [0.2, 1.7]
Azerbaijan 2006	12.2 [10.2, 14.5]	28.9 [26.0, 32.1]	3.6 [2.4, 5.2]
Kyrgyz Republic 2012	8.6 [7.0, 10.4]	34.4 [31.2, 37.8]	2.3 [1.6, 3.2]
Moldova 2005	11.2 [9.5, 13.1]	23.4 [21.0, 25.8]	2.7 [1.9, 3.7]
Tajikistan 2017	12.7 [11.0, 14.7]	33.3 [30.3, 36.3]	3.3 [2.4, 4.6]
AMERICAS REGION			
Regional prevalence	**18.7 [13.8, 23.6]**	**26.6 [17.1, 36.2]**	**5.1 [3.8, 6.4]**
Bolivia 2008	29.2 [27.0, 31.4]	36.0 [32.5, 39.7]	10.3 [8.2, 12.8]
Guatemala 2014-15	28.9 [27.3, 30.5]	10.4 [9.4, 11.5]	2.8 [2.3, 3.3]
Guyana 2009	21.4 [17.9, 25.3]	33.9 [29.7, 38.3]	7.6 [5.7, 10.0]
Haiti 2016-17	11.2 [9.7, 12.8]	52.7 [49.9, 55.4]	6.0 [4.8, 7.4]
Honduras 2011-12	25.3 [23.7, 26.9]	12.0 [10.8, 13.3]	2.6 [2.1, 3.2]
Peru 2012	28.2 [26.4, 30.1]	15.8 [14.4, 17.3]	3.8 [3.1, 4.7]
SOUTHEAST ASIAN REGION			
Regional prevalence	**5.7 [3.9, 7.6]**	**43.4 [31.7, 55.2]**	**3.0 [1.8, 4.1]**
India 2015-16	5.3 [5.1, 5.5]	54.1 [53.6, 54.5]	2.4 [2.2, 2.5]
Maldives 2016-17	18.5 [15.3, 22.2]	59.8 [55.6, 64.0]	10.2 [7.5, 13.6]
Myanmar 2015-16	6.2 [4.8, 8.1]	47.5 [44.3, 50.6]	2.2 [1.3, 3.6]
Nepal 2016	5.2 [4.0, 6.8]	43.6 [39.6, 47.6]	2.0 [1.3, 3.1]
Timor-Leste 2016	2.7 [2.1, 3.6]	20.7 [17.5, 24.3]	0.5 [0.2, 1.3]
WESTERN PACIFIC			
Regional prevalence	**-**	**-**	**-**
Cambodia 2014	4.5 [3.5, 5.8]	48.6 [45.7, 51.5]	1.6 [1.1, 2.5]
OVERALL POOLED PREVALENCE	**11.3 [9.9, 12.7]**	**38.8 [33.7, 43.9]**	**4.5 [4.0, 5.0]**

*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
We used the most recent dataset available for each country. Estimates were not calculated or are missing for that country due to i) data not available for one or more age groups (i.e., Angola) or ii) children's anthropometric measures were unreliable in the most recent survey (i.e., Jordan and Madagascar).
DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity; DBM, concurrent overweight/obesity and anaemia.

Table 5.9. Concurrent overweight/obesity and anaemia by household wealth quintiles among adolescent girls (15-19 years old).

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
Regional prevalence	**2.3 [1.7, 2.9]**	**3.1 [2.4, 3.8]**	**3.8 [3.0, 4.7]**	**5.6 [4.4, 6.8]**	**7.1 [5.7, 8.4]**	**4.8**	-
Benin 2017-18	2.3 [1.0, 5.6]	2.6 [1.2, 5.7]	4.3 [2.5, 7.3]	5.1 [3.1, 8.2]	8.6 [6.1, 12.1]	6.3	0.0034
Burkina Faso 2010	0.0 [0.0, 0.0]	1.3 [0.3, 5.6]	1.5 [0.5, 4.5]	2.1 [1.0, 4.4]	4.8 [2.9, 7.9]	4.8	0.0052
Burundi 2016-17	1.5 [0.6, 4.1]	1.0 [0.3, 3.3]	1.0 [0.3, 3.3]	1.9 [0.8, 4.7]	2.7 [1.3, 5.2]	1.2	0.4692
Cameroon 2011	1.3 [0.4, 4.1]	3.8 [2.3, 6.5]	8.8 [5.4, 14.0]	8.2 [5.7, 11.5]	11.0 [8.4, 14.5]	9.7	0.0001
Congo 2011-12	2.4 [1.2, 4.8]	1.9 [0.9, 4.0]	1.5 [0.4, 5.4]	5.8 [2.3, 13.9]	3.4 [1.2, 9.6]	1.0	0.1579
Cote d'Ivoire 2011-12	3.7 [0.9, 13.7]	2.7 [0.7, 9.7]	9.0 [4.5, 17.1]	13.8 [8.2, 22.1]	10.8 [6.7, 17.0]	7.1	0.0561
DRC 2013-14	0.3 [0.1, 1.5]	2.0 [0.8, 5.1]	2.1 [1.1, 3.9]	2.9 [1.3, 6.4]	5.7 [3.6, 9.0]	5.4	0.0030
Eswatini 2006-07	5.5 [3.7, 8.3]	6.6 [4.8, 9.1]	7.8 [5.5, 11.0]	8.7 [5.8, 12.9]	11.6 [8.6, 15.5]	6.1	0.2410
Ethiopia 2016	0.3 [0.1, 0.8]	0.6 [0.2, 2.4]	1.1 [0.3, 3.5]	0.1 [0.0, 0.7]	2.2 [1.2, 4.0]	1.9	0.0047
Gabon 2012	10.6 [6.4, 17.0]	9.3 [3.9, 20.6]	15.2 [7.4, 28.5]	7.0 [3.7, 12.9]	12.5 [6.0, 24.3]	1.9	0.5327
Gambia 2013	5.0 [2.7, 9.0]	4.5 [2.4, 8.2]	6.4 [3.3, 12.1]	4.7 [2.2, 9.6]	9.6 [4.8, 18.1]	4.6	0.2924

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.
¶ Missing estimates for certain categories are missing for Egypt and Jordan due to sample size <25, and thus, the pooled prevalence is missing for the Eastern and Mediterranean region.

Table 5.9. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
Ghana 2014	1.6 [0.7, 3.7]	0.8 [0.2, 3.4]	6.0 [2.6, 13.3]	6.7 [3.4, 12.7]	13.2 [7.9, 21.2]	11.6	0.0000
Guinea 2018	3.3 [1.5, 7.0]	4.5 [2.2, 8.9]	6.5 [4.1, 11.2]	9.3 [6.3, 13.7]	10.0 [6.4, 15.4]	6.7	0.0407
Lesotho 2014	2.8 [1.1, 6.5]	4.8 [2.1, 10.5]	6.9 [2.9, 15.8]	12.6 [7.1, 21.3]	5.1 [2.5, 10.3]	2.3	0.0514
Madagascar 2008-09	0.7 [0.2, 2.8]	0.0 [0.0, 0.0]	0.4 [0.1, 2.6]	0.5 [0.2, 1.8]	0.8 [0.3, 2.0]	0.1	0.5905
Malawi 2015-16	0.2 [0.0, 1.2]	1.5 [0.6, 4.5]	1.7 [0.6, 4.9]	3.2 [1.6, 6.2]	7.6 [4.7, 12.2]	7.4	0.0000
Mali 2018	3.9 [1.2, 12.0]	6.4 [2.3, 16.4]	5.2 [2.2, 11.9]	7.3 [4.3, 12.2]	8.0 [4.7, 13.4]	4.1	0.7764
Mozambique 2011	3.3 [1.1, 9.0]	2.7 [1.4, 5.1]	2.7 [1.4, 5.2]	4.4 [3.0, 6.5]	10.6 [8.5, 13.0]	7.3	0.0001
Namibia 2013	0.8 [0.1, 6.1]	0.4 [0.1, 3.1]	0.7 [0.1, 4.7]	2.0 [0.7, 5.6]	3.6 [1.0, 12.1]	2.8	0.1786
Niger 2012	0.7 [0.1, 5.4]	1.4 [0.3, 5.7]	0.7 [0.1, 5.1]	1.0 [0.2, 5.3]	3.4 [1.8, 6.5]	2.7	0.2146
Nigeria 2018	1.0 [0.5, 1.8]	4.6 [3.0, 6.9]	4.8 [2.8, 8.0]	10.7 [6.4, 17.2]	9.2 [6.4, 13.0]	8.2	0.0003
Rwanda 2014-15	3.3 [1.5, 7.1]	1.8 [0.7, 4.9]	2.6 [1.0, 6.5]	2.7 [1.3, 5.7]	3.9 [2.6, 5.8]	0.6	0.6977
STP 2008-09	7.6 [3.8, 14.5]	8.4 [3.9, 17.2]	16.2 [8.4, 28.9]	6.1 [2.2, 15.9]	4.5 [1.5, 12.6]	-3.1	0.1532

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.
¶ Missing estimates for certain categories are missing for Egypt and Jordan due to sample size <25, and thus, the pooled prevalence is missing for the Eastern and Mediterranean region.

Table 5.9. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
Senegal 2010-11	2.9 [1.3, 6.2]	3.4 [1.7, 6.4]	4.0 [1.9, 8.0]	6.5 [2.9, 14.0]	7.4 [3.0, 16.8]	4.5	0.3874
Sierra Leone 2013	5.5 [2.7, 11.0]	3.7 [1.7, 7.8]	2.1 [0.9, 4.9]	6.2 [3.8, 10.2]	6.2 [4.0, 9.5]	0.7	0.2558
South Africa 2016	9.6 [5.4, 16.4]	11.8 [7.0, 19.3]	11.0 [5.4, 21.3]	9.2 [4.8, 17.1]	12.2 [3.3, 36.3]	2.6	0.9691
Tanzania 2015-16	3.8 [2.0, 7.2]	4.4 [2.7, 7.1]	6.9 [4.7, 10.0]	5.1 [3.3, 7.8]	9.6 [6.4, 14.1]	5.8	0.0132
Togo 2013-14	1.3 [0.3, 5.3]	2.4 [0.7, 7.9]	7.1 [3.7, 13.2]	8.1 [4.6, 13.8]	16.6 [11.5, 23.3]	15.3	0.0000
Uganda 2016	0.7 [0.2, 2.8]	2.6 [0.9, 7.3]	2.5 [1.0, 6.3]	4.9 [2.6, 9.2]	7.3 [4.1, 12.6]	6.6	0.0108
Zimbabwe 2015	2.3 [1.1, 4.9]	3.6 [1.4, 8.8]	3.1 [1.8, 5.3]	6.7 [3.8, 11.7]	5.5 [3.6, 8.4]	3.2	0.1343
EASTERN MEDITERRANEAN REGION							
Regional prevalence	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Egypt 2014¶	17.7 [5.0, 46.6]	11.4 [3.7, 30.1]	7.2 [2.2, 21.3]	12.0 [12.0, 12.0]	-	-	-
Jordan 2017-18¶	26.2 [15.7, 40.3]	13.9 [4.4, 36.3]	-	-	-	-	-
Yemen 2013	0.2 [0.0, 1.2]	1.6 [0.7, 4.0]	4.1 [2.4, 6.9]	9.4 [5.6, 15.2]	10.8 [7.0, 16.3]	10.6	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.
¶ Missing estimates for certain categories are missing for Egypt and Jordan due to sample size <25, and thus, the pooled prevalence is missing for the Eastern and Mediterranean region.

Table 5.9. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
EUROPEAN REGION							
Regional prevalence	**2.8 [1.8, 3.8]**	**2.9 [2.0, 3.7]**	**3.1 [2.2, 3.9]**	**2.3 [1.5, 3.0]**	**2.4 [0.7, 4.1]**	**-0.4**	**-**
Albania 2017-18	1.4 [0.7, 2.8]	2.0 [0.8, 4.5]	2.6 [1.3, 5.0]	2.8 [1.0, 7.5]	10.1 [4.9, 19.5]	8.7	0.0001
Armenia 2015-16	1.8 [0.5, 7.0]	0.0 [0.0, 0.0]	0.0 [0.0, 0.0]	1.3 [0.6, 2.9]	0.0 [0.0, 0.0]	-1.8	0.2750
Azerbaijan 2006	3.3 [2.0, 5.4]	5.0 [3.7, 6.8]	4.6 [2.1, 9.6]	3.3 [0.9, 11.3]	1.8 [0.6, 4.7]	-1.5	0.5369
Kyrgyz Republic 2012	4.9 [2.8, 8.5]	2.2 [1.1, 4.3]	2.5 [1.1, 5.4]	1.9 [0.7, 5.0]	0.4 [0.1, 3.1]	-4.5	0.0179
Moldova 2005	3.9 [2.5, 6.0]	2.0 [1.0, 4.0]	2.4 [1.3, 4.1]	3.0 [1.7, 5.1]	2.0 [1.2, 3.2]	-1.9	0.5875
Tajikistan 2017	3.5 [1.6, 7.8]	3.1 [1.5, 6.4]	3.1 [1.7, 5.6]	2.6 [1.3, 5.2]	4.2 [2.4, 7.1]	0.7	0.8784
AMERICAS REGION							
Regional prevalence	**4.6 [2.9, 6.3]**	**4.7 [3.0, 6.4]**	**3.7 [2.6, 4.8]**	**5.7 [3.7, 7.7]**	**4.3 [3.0, 5.7]**	**-0.3**	**-**
Bolivia 2008	8.5 [4.6, 15.1]	15.3 [10.1, 22.5]	8.9 [5.1, 15.2]	12.8 [8.5, 19.0]	6.0 [3.2, 11.0]	-2.5	0.0644

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.
¶ Missing estimates for certain categories are missing for Egypt and Jordan due to sample size <25, and thus, the pooled prevalence is missing for the Eastern and Mediterranean region.

Table 5.9. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AMERICAS REGION							
Guatemala 2014-15	4.0 [2.8, 5.5]	2.1 [1.3, 3.2]	1.8 [1.2, 2.9]	3.6 [2.5, 5.1]	2.6 [1.7, 4.1]	-1.4	0.0319
Guyana 2009	11.9 [6.9, 19.7]	6.2 [3.1, 11.7]	2.2 [0.7, 7.1]	12.1 [7.4, 19.3]	5.9 [2.8, 11.9]	-6.0	0.0142
Haiti 2016-17	3.6 [1.9, 6.5]	5.5 [3.4, 8.7]	5.4 [3.3, 8.7]	8.2 [5.7, 11.8]	6.4 [4.3, 9.6]	2.8	0.1866
Honduras 2011-12	1.4 [0.8, 2.3]	2.5 [1.6, 3.8]	3.1 [2.1, 4.5]	2.7 [1.7, 4.4]	2.8 [1.8, 4.5]	1.4	0.2989
Peru 2012	4.9 [3.5, 6.9]	4.7 [3.4, 6.5]	2.9 [1.6, 5.1]	2.5 [1.4, 4.5]	4.3 [2.5, 7.1]	-0.6	0.2243
SOUTHEAST ASIAN REGION							
Regional prevalence	**2.0 [0.6, 3.4]**	**2.7 [1.0, 4.4]**	**2.9 [1.3, 4.5]**	**3.0 [2.2, 3.9]**	**3.1 [1.5, 4.7]**	**1.1**	**-**
India 2015-16	0.9 [0.7, 1.1]	1.4 [1.2, 1.6]	2.1 [1.9, 2.5]	3.4 [3.0, 3.8]	4.9 [4.3, 5.8]	4.0	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.
¶ Missing estimates for certain categories are missing for Egypt and Jordan due to sample size <25, and thus, the pooled prevalence is missing for the Eastern and Mediterranean region.

Table 5.9. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION							
Maldives 2016-17	10.3 [7.1, 14.7]	7.3 [4.7, 11.2]	8.9 [5.1, 15.1]	7.2 [2.8, 17.4]	17.5 [8.8, 31.8]	7.2	0.1466
Myanmar 2015-16	2.1 [0.9, 4.9]	1.4 [0.4, 4.5]	1.9 [0.7, 4.6]	2.4 [0.9, 6.3]	2.9 [1.2, 6.5]	0.8	0.8301
Nepal 2016	0.5 [0.1, 2.1]	2.4 [1.1, 5.4]	1.4 [0.5, 4.2]	3.7 [1.6, 8.3]	1.4 [0.5, 4.2]	0.9	0.1161
Timor-Leste 2016	1.2 [0.2, 8.6]	0.0 [0.0, 0.0]	0.0 [0.0, 0.0]	0.0 [0.0, 0.0]	1.6 [0.7, 3.6]	0.4	0.2725
WESTERN PACIFIC REGION							
Regional prevalence	-	-	-	-	-	-	-
Cambodia 2014	0.5 [0.1, 2.0]	1.0 [0.4, 2.5]	1.5 [0.4, 4.9]	2.2 [0.9, 5.2]	2.4 [1.2, 4.6]	1.9	0.3545
OVERALL POOLED PREVALENCE	**2.4 [2.0, 2.9]**	**3.1 [2.6, 3.6]**	**3.4 [2.9, 3.8]**	**4.7 [4.0, 5.3]**	**5.7 [4.9, 6.5]**	**3.3**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.
¶ Missing estimates for certain categories are missing for Egypt and Jordan due to sample size <25, and thus, the pooled prevalence is missing for the Eastern and Mediterranean region.

Table 5.10. Concurrent overweight/obesity and anaemia by education level among adolescent girls (15-19 years old).

	Education level*				
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary or higher (E3)**	**Gap†**	**p-value‡**
	AFRICAN REGION				
Regional prevalence	**3.1 [2.2, 4.0]**	**3.9 [3.0, 4.8]**	**5.3 [4.1, 6.6]**	**2.2**	**-**
Benin 2017-18	3.6 [2.2, 5.8]	4.2 [2.5, 6.8]	6.2 [4.6, 8.3]	2.6	0.1126
Burkina Faso 2010	1.3 [0.6, 2.6]	1.8 [0.6, 5.0]	5.6 [3.1, 10.1]	4.3	0.0027
Burundi 2016-17	3.3 [0.7, 14.5]	1.2 [0.6, 2.3]	1.9 [1.1, 3.3]	-1.4	0.3740
Cameroon 2011	3.0 [0.4, 18.3]	6.8 [4.6, 9.9]	8.0 [6.4, 9.9]	5.0	0.3686
Congo 2011-12	1.6 [1.3, 2.0]	4.7 [2.0, 10.6]	2.6 [1.3, 5.1]	1.0	0.3195
Cote d'Ivoire 2011-12	11.4 [7.6, 16.9]	9.9 [5.9, 16.2]	5.8 [3.1, 10.8]	-5.6	0.1594
DRC 2013-14	1.5 [0.3, 7.4]	2.8 [1.5, 5.1]	3.3 [2.0, 5.3]	1.8	0.6472
Eswatini 2006-07	-	6.9 [5.1, 9.2]	8.8 [6.7, 11.6]	-	-
Ethiopia 2016	2.0 [0.8, 4.9]	0.8 [0.4, 1.6]	1.0 [0.5, 2.2]	-1.0	0.2219

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E3 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Eswatini, Gabon, Lesotho, Namibia, Rwanda, Sao Tome and Principe, South Africa, Zimbabwe, Egypt, Jordan, Albania, Armenia, Kyrgyz Republic, Moldova, Tajikistan, Bolivia, Guyana, Peru and Maldives due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the Eastern Mediterranean and the European region could not be calculated.

Table 5.10. (continued)

	Education level*				
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary or higher (E3)**	**Gap†**	**p-value‡**
AFRICAN REGION					
Ghana 2014	0.0 [0.0, 0.0]	3.9 [1.6, 9.0]	6.2 [4.3, 8.8]	6.2	0.2761
Guinea 2018	5.1 [3.6, 7.3]	9.6 [5.9, 15.2]	8.8 [6.0, 12.8]	3.7	0.0760
Lesotho 2014¶	-	4.2 [2.1, 8.2]	8.0 [5.5, 11.4]	-	-
Madagascar 2008-09	0.3 [0.0, 2.1]	0.7 [0.3, 1.5]	0.4 [0.1, 1.2]	0.1	0.6094
Malawi 2015-16	0.0 [0.0, 0.0]	2.5 [1.5, 4.1]	5.3 [3.2, 8.9]	5.3	0.0636
Mali 2018	7.6 [4.8, 12.0]	3.0 [1.1, 8.0]	6.9 [4.2, 11.0]	-0.7	0.2276
Mozambique 2011	3.3 [1.7, 6.2]	4.4 [3.3, 5.9]	7.7 [6.0, 9.8]	4.4	0.0034
Namibia 2013¶	-	1.1 [0.3, 4.7]	1.8 [0.8, 4.2]	-	-
Niger 2012	1.2 [0.6, 2.7]	2.9 [1.2, 7.0]	1.4 [0.5, 3.9]	0.2	0.2608
Nigeria 2018	2.4 [1.4, 4.0]	3.3 [1.7, 6.5]	8.2 [6.4, 10.4]	5.8	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E3 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Eswatini, Gabon, Lesotho, Namibia, Rwanda, Sao Tome and Principe, South Africa, Zimbabwe, Egypt, Jordan, Albania, Armenia, Kyrgyz Republic, Moldova, Tajikistan, Bolivia, Guyana, Peru and Maldives due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the Eastern Mediterranean and the European region could not be calculated.

Table 5.10. (continued)

	Education level*				
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary or higher (E3)**	**Gap†**	**p-value‡**
AFRICAN REGION					
Rwanda 2014-15¶	-	3.5 [2.4, 5.1]	2.3 [1.4, 3.7]	-	-
STP 2008-09¶	-	5.5 [3.1, 9.5]	8.4 [5.0, 13.7]	-	-
Senegal 2010-11	5.0 [2.8, 9.0]	3.0 [1.2, 7.5]	6.1 [3.3, 10.9]	1.1	0.4595
Sierra Leone 2013	3.0 [1.2, 7.8]	7.3 [4.3, 12.3]	5.0 [3.6, 6.8]	2.0	0.2093
South Africa 2016¶	-	8.8 [2.2, 29.6]	10.8 [7.9, 14.5]	-	-
Tanzania 2015-16	3.4 [1.3, 8.9]	6.3 [4.9, 8.0]	7.3 [5.4, 10.0]	3.9	0.2534
Togo 2013-14	1.4 [0.2, 9.8]	10.1 [6.6, 15.2]	8.2 [5.7, 11.6]	6.8	0.0679
Uganda 2016	0.0 [0.0, 0.0]	2.0 [1.1, 3.5]	7.3 [4.8, 11.0]	7.3	0.0003
Zimbabwe 2015¶	-	1.3 [0.4, 4.2]	5.2 [3.9, 6.9]	-	-

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E3 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Eswatini, Gabon, Lesotho, Namibia, Rwanda, Sao Tome and Principe, South Africa, Zimbabwe, Egypt, Jordan, Albania, Armenia, Kyrgyz Republic, Moldova, Tajikistan, Bolivia, Guyana, Peru and Maldives due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the Eastern Mediterranean and the European region could not be calculated.

Table 5.10. (continued)

	Education level*				
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary or higher (E3)**	**Gap†**	**p-value‡**
EASTERN MEDITERRANEAN REGION					
Regional prevalence	-	-	-	-	-
Egypt 2014¶	-	-	15.2 [7.8, 27.6]	-	-
Jordan 2017-18¶	-	-	22.3 [12.7, 36.3]	-	-
Yemen 2013§	-	-	-	-	-
EUROPEAN REGION					
Regional prevalence	-	-	-	-	-
Albania 2017-18¶	-	2.6 [1.4, 4.7]	3.9 [2.3, 6.6]	-	-
Armenia 2015-16¶	-	1.4 [0.3, 5.7]	0.5 [0.1, 1.9]	-	-
Azerbaijan 2006	4.7 [3.5, 6.1]	10.5 [10.2, 10.9]	3.4 [2.1, 5.3]	-1.3	0.1679

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E3 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Eswatini, Gabon, Lesotho, Namibia, Rwanda, Sao Tome and Principe, South Africa, Zimbabwe, Egypt, Jordan, Albania, Armenia, Kyrgyz Republic, Moldova, Tajikistan, Bolivia, Guyana, Peru and Maldives due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the Eastern Mediterranean and the European region could not be calculated.

Table 5.10. (continued)

	Education level*				
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary or higher (E3)**	**Gap†**	**p-value‡**
EUROPEAN REGION					
Kyrgyz Republic 2012¶	-	-	2.3 [1.6, 3.2]	-	-
Moldova 2005¶	-	-	2.7 [1.9, 3.7]	-	-
Tajikistan 2017¶	-	0.0 [0.0, 0.0]	3.4 [2.5, 4.7]	-	-
AMERICAS REGION					
Regional prevalence	**4.4 [0.9, 7.9]**	**2.8 [2.2, 3.4]**	**4.0 [2.5, 5.5]**	**-0.4**	**-**
Bolivia 2008¶	-	12.5 [8.5, 18.0]	9.5 [7.2, 12.5]	-	-
Guatemala 2014-15	5.1 [2.5, 10.2]	2.5 [1.9, 3.3]	2.9 [2.2, 3.7]	-2.2	0.2156
Guyana 2009¶	-	8.7 [2.4, 27.1]	7.5 [5.6, 10.0]	-	-

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E3 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Eswatini, Gabon, Lesotho, Namibia, Rwanda, Sao Tome and Principe, South Africa, Zimbabwe, Egypt, Jordan, Albania, Armenia, Kyrgyz Republic, Moldova, Tajikistan, Bolivia, Guyana, Peru and Maldives due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the Eastern Mediterranean and the European region could not be calculated.

Table 5.10. (continued)

	Education level*				
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary or higher (E3)**	**Gap†**	**p-value‡**
		AMERICAS REGION			
Haiti 2016-17	12.0 [2.8, 38.9]	3.6 [2.3, 5.5]	7.0 [5.5, 8.9]	-5.0	0.0191
Honduras 2011-12	1.5 [1.4, 1.7]	2.2 [1.6, 3.1]	2.8 [2.1, 3.6]	1.3	0.3914
Peru 2012¶	-	5.6 [3.5, 8.8]	3.6 [2.9, 4.5]	-	-
		SOUTHEAST ASIAN REGION			
Regional prevalence	**1.3 [0.9, 1.7]**	**1.6 [1.3, 1.9]**	**1.7 [0.9, 2.6]**	**0.4**	**-**
India 2015-16	1.3 [1.0, 1.7]	1.7 [1.4, 2.1]	2.5 [2.4, 2.7]	1.2	0.0000
Maldives 2016-17¶	-	-	10.3 [7.6, 13.7]	-	-

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E3 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Eswatini, Gabon, Lesotho, Namibia, Rwanda, Sao Tome and Principe, South Africa, Zimbabwe, Egypt, Jordan, Albania, Armenia, Kyrgyz Republic, Moldova, Tajikistan, Bolivia, Guyana, Peru and Maldives due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the Eastern Mediterranean and the European region could not be calculated.

Table 5.10. (continued)

	Education level*				
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary or higher (E3)**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION					
Myanmar 2015-16	2.3 [0.7, 6.9]	2.0 [0.6, 6.5]	2.2 [1.3, 3.6]	-0.1	0.9645
Nepal 2016	3.7 [1.0, 12.2]	1.5 [0.5, 4.8]	2.0 [1.2, 3.3]	-1.7	0.5764
Timor-Leste 2016	2.6 [0.3, 17.4]	0.0 [0.0, 0.0]	0.4 [0.2, 1.0]	-2.2	0.0995
WESTERN PACIFIC REGION					
Regional prevalence	**-**	**-**	**-**	**-**	**-**
Cambodia 2014	4.5 [0.5, 30.4]	1.7 [0.7, 4.1]	1.5 [0.9, 2.5]	-3.0	0.4907
OVERALL POOLED PREVALENCE	**2.9 [2.2, 3.6]**	**3.3 [2.7, 3.9]**	**4.3 [3.7, 5.0]**	**1.4**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest education level (%E3 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Eswatini, Gabon, Lesotho, Namibia, Rwanda, Sao Tome and Principe, South Africa, Zimbabwe, Egypt, Jordan, Albania, Armenia, Kyrgyz Republic, Moldova, Tajikistan, Bolivia, Guyana, Peru and Maldives due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the Eastern Mediterranean and the European region could not be calculated.

Table 5.11. Concurrent overweight/obesity and anaemia by area of residence among adolescent girls (15-19 years old).

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Regional prevalence	**6.7 [5.5, 7.9]**	**3.7 [3.0, 4.4]**	**3.0**	**-**
Benin 2017-18	7.7 [5.8, 10.2]	3.0 [2.0, 4.3]	4.7	0.0001
Burkina Faso 2010	5.0 [3.1, 7.9]	1.0 [0.5, 2.1]	4.0	0.0001
Burundi 2016-17	3.1 [1.3, 7.2]	1.5 [0.9, 2.4]	1.6	0.1299
Cameroon 2011	10.0 [8.0, 12.5]	3.8 [2.5, 5.5]	6.2	0.0000
Congo 2011-12	3.0 [1.5, 6.2]	2.8 [1.7, 4.5]	0.2	0.8531
Cote d'Ivoire 2011-12	11.2 [7.9, 15.8]	5.3 [2.9, 9.6]	5.9	0.0283
DRC 2013-14	4.9 [3.1, 7.6]	1.7 [0.9, 3.0]	3.2	0.0034
Eswatini 2006-07	7.6 [4.8, 11.8]	8.3 [6.4, 10.8]	-0.7	0.7128
Ethiopia 2016	2.8 [1.5, 5.0]	0.5 [0.2, 1.0]	2.3	0.0001
Gabon 2012	10.9 [7.9, 14.9]	11.0 [7.1, 16.8]	-0.1	0.9777
Gambia 2013	7.1 [4.4, 11.4]	5.1 [3.4, 7.4]	2.0	0.2854

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.
¶There is a missing estimate for concurrent overweight/obesity and anaemia among rural residents in Jordan, due to sample size <25 observations.

Table 5.11. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Ghana 2014	8.0 [5.4, 11.6]	2.7 [1.4, 5.3]	5.3	0.0037
Guinea 2018	9.1 [6.5, 12.5]	5.9 [4.2, 8.1]	3.2	0.0657
Lesotho 2014	9.1 [5.0, 15.9]	5.9 [3.8, 9.9]	3.2	0.2390
Madagascar 2008-09	1.1 [0.4, 2.8]	0.4 [0.2, 0.9]	0.7	0.0973
Malawi 2015-16	8.5 [5.0, 14.1]	2.1 [1.3, 3.3]	6.4	0.0000
Mali 2018	8.6 [5.6, 13.0]	5.5 [3.5, 8.5]	3.1	0.1467
Mozambique 2011	7.5 [6.2, 9.2]	3.9 [2.8, 5.6]	3.6	0.0012
Namibia 2013	2.2 [0.8, 6.4]	1.1 [0.4, 2.8]	1.1	0.3228
Niger 2012	3.8 [2.0, 7.1]	0.9 [0.4, 2.4]	2.9	0.0093
Nigeria 2018	8.5 [6.3, 11.5]	4.5 [3.3, 5.9]	4.0	0.0018
Rwanda 2014-15	3.8 [2.3, 6.2]	2.7 [1.8, 4.0]	1.1	0.2836
STP 2008-09	5.5 [3.2, 9.4]	11.9 [7.2, 19.1]	-6.4	0.0323

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.
¶There is a missing estimate for concurrent overweight/obesity and anaemia among rural residents in Jordan, due to sample size <25 observations.

Table 5.11. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Senegal 2010-11	7.4 [4.5, 12.1]	2.6 [1.6, 4.2]	4.8	0.0023
Sierra Leone 2013	6.2 [4.3, 8.8]	4.2 [2.7, 6.3]	2.0	0.1648
South Africa 2016	9.6 [5.8, 15.3]	11.9 [8.4, 16.5]	-2.3	0.4686
Tanzania 2015-16	9.6 [6.7, 13.5]	4.6 [3.6, 5.7]	5.0	0.0004
Togo 2013-14	12.3 [8.7, 17.0]	4.4 [2.7, 7.2]	7.9	0.0004
Uganda 2016	6.0 [3.3, 10.6]	3.2 [2.1, 4.9]	2.8	0.0889
Zimbabwe 2015	6.8 [4.6, 10.0]	3.1 [2.1, 4.6]	3.7	0.0046
EASTERN MEDITERRANEAN REGION				
Regional prevalence	**12.6 [9.6, 15.5]**	**3.5 [2.5, 4.5]**	**9.1**	**-**
Egypt 2014	10.6 [2.1, 38.9]	13.6 [7.4, 23.6]	-3.0	0.7403
Jordan 2017-18¶	23.8 [14.1, 37.3]	-	-	-
Yemen 2013	11.5 [7.9, 16.3]	2.5 [1.7, 3.7]	9.0	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.
¶There is a missing estimate for concurrent overweight/obesity and anaemia among rural residents in Jordan, due to sample size <25 observations.

Table 5.11. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
EUROPEAN REGION				
Regional prevalence	**2.1 [1.0, 3.2]**	**2.7 [1.8, 3.6]**	**-0.6**	**-**
Albania 2017-18	4.6 [2.6, 8.1]	2.1 [1.3, 3.6]	2.5	0.0456
Armenia 2015-16	0.2 [0.0, 1.3]	1.1 [0.4, 3.5]	-0.9	0.0670
Azerbaijan 2006	3.0 [1.5, 5.9]	4.3 [2.8, 6.6]	-1.3	0.3591
Kyrgyz Republic 2012	0.9 [0.3, 2.4]	3.1 [2.1, 4.5]	-2.2	0.0165
Moldova 2005	2.3 [1.5, 3.7]	2.9 [1.8, 4.5]	-0.6	0.5342
Tajikistan 2017	3.9 [2.3, 6.4]	3.2 [2.1, 4.7]	0.7	0.5387
AMERICAS REGION				
Regional prevalence	**5.2 [3.7, 6.7]**	**4.9 [3.5, 6.4]**	**0.3**	**-**
Bolivia 2008	9.5 [7.1, 12.6]	11.9 [8.4, 16.7]	-2.4	0.3114

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.
¶There is a missing estimate for concurrent overweight/obesity and anaemia among rural residents in Jordan, due to sample size <25 observations.

Table 5.11. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AMERICAS REGION				
Guatemala 2014-15	2.6 [1.9, 3.5]	2.9 [2.3, 3.7]	-0.3	0.4981
Guyana 2009	8.6 [5.4, 13.6]	7.1 [5.0, 10.0]	1.5	0.5055
Haiti 2016-17	6.9 [5.3, 9.0]	5.2 [3.7, 7.3]	1.7	0.1944
Honduras 2011-12	3.0 [2.3, 4.0]	2.0 [1.5, 2.8]	1.0	0.0714
Peru 2012	3.4 [2.6, 4.5]	5.0 [3.8, 6.5]	-1.6	0.0480
SOUTHEAST ASIAN REGION				
Regional prevalence	**3.0 [1.7, 4.3]**	**2.3 [1.2, 3.5]**	**0.7**	**-**
India 2015-16	4.0 [3.6, 4.5]	1.7 [1.6, 1.8]	2.3	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.
¶There is a missing estimate for concurrent overweight/obesity and anaemia among rural residents in Jordan, due to sample size <25 observations.

Table 5.11. (continued)

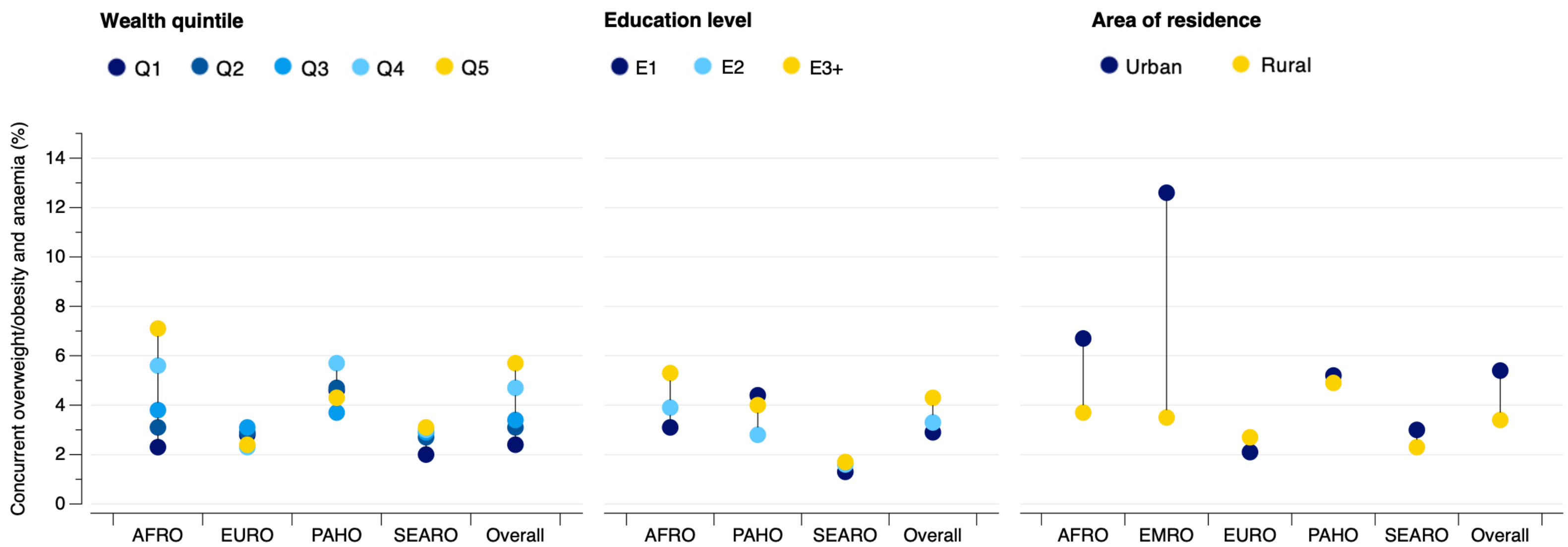
	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION				
Maldives 2016-17	11.2 [6.6, 18.6]	9.1 [7.2, 11.5]	2.1	0.4711
Myanmar 2015-16	3.6 [1.5, 8.3]	1.5 [0.9, 2.5]	2.1	0.0715
Nepal 2016	2.6 [1.6, 4.2]	1.0 [0.4, 2.8]	1.6	0.0975
Timor-Leste 2016	0.9 [0.4, 2.4]	0.3 [0.1, 1.6]	0.6	0.2498
WESTERN PACIFIC REGION				
Regional prevalence	**-**	**-**	**-**	**-**
Cambodia 2014	2.0 [0.9, 4.1]	1.5 [0.9, 2.6]	0.5	0.6084
OVERALL POOLED PREVALENCE	**5.4 [4.8, 6.1]**	**3.4 [3.0, 3.9]**	**2.0**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.
¶There is a missing estimate for concurrent overweight/obesity and anaemia among rural residents in Jordan, due to sample size <25 observations.

Patterns in the distribution of concurrent overweight/obesity and anaemia were similar to those of adult women, although with more variation across and within regions. Overall, the highest prevalence was found in the fifth richest quintile (5.7%), third education level (4.3%), and urban residents (5.4%) (**Figure 5.5** and **Tables 5.9, 5.10** and **5.11**). A distinct pattern was also observed in the European region, where the prevalence of DBM was higher in rural residents, and in the Americas region, with a higher prevalence of DBM observed among the least educated.

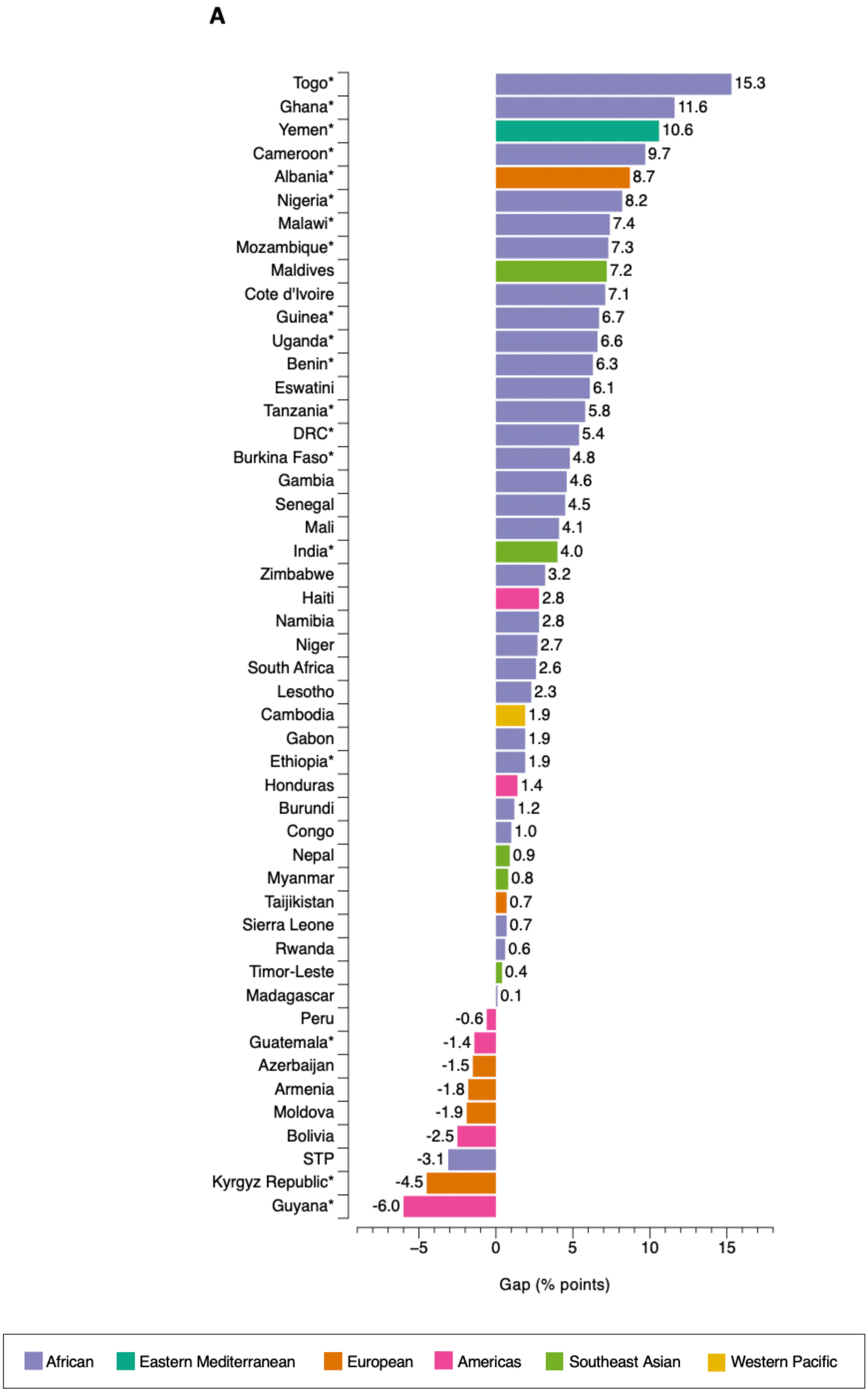
The largest gaps were observed in Togo, with a 15.3 pp difference ($p<0.001$) in DBM prevalence by household wealth; in Uganda, with a 19.5 pp difference ($p<0.001$) by education level; and in Yemen, with a 9.0 pp difference ($p<0.001$) by area of residence (**Figure 5.6** and **Tables 5.9, 5.10** and **5.11**). Gaps were positive in 81.6% (40/49), 64.5% (20/31) and 76.0% (38/50) of countries by household wealth, education level and area of residence, respectively; whereas these were negative in 18.4% (9/49) of countries by household wealth, 35.5% (11/31) by education level, and 24.0% (12/50) by area of residence (**Figure 4**). Differences observed across groups were significant in less than half of the countries for the three socioeconomic measures. For example, by education level, differences observed between the least and most educated was only significant in Uganda, Nigeria, Mozambique, Burkina Faso, India and Haiti.

Figure 5.5. Distribution of concurrent overweight/obesity and anaemia among adolescent girls by wealth quintile, education level and area of residence across WHO regions and overall.



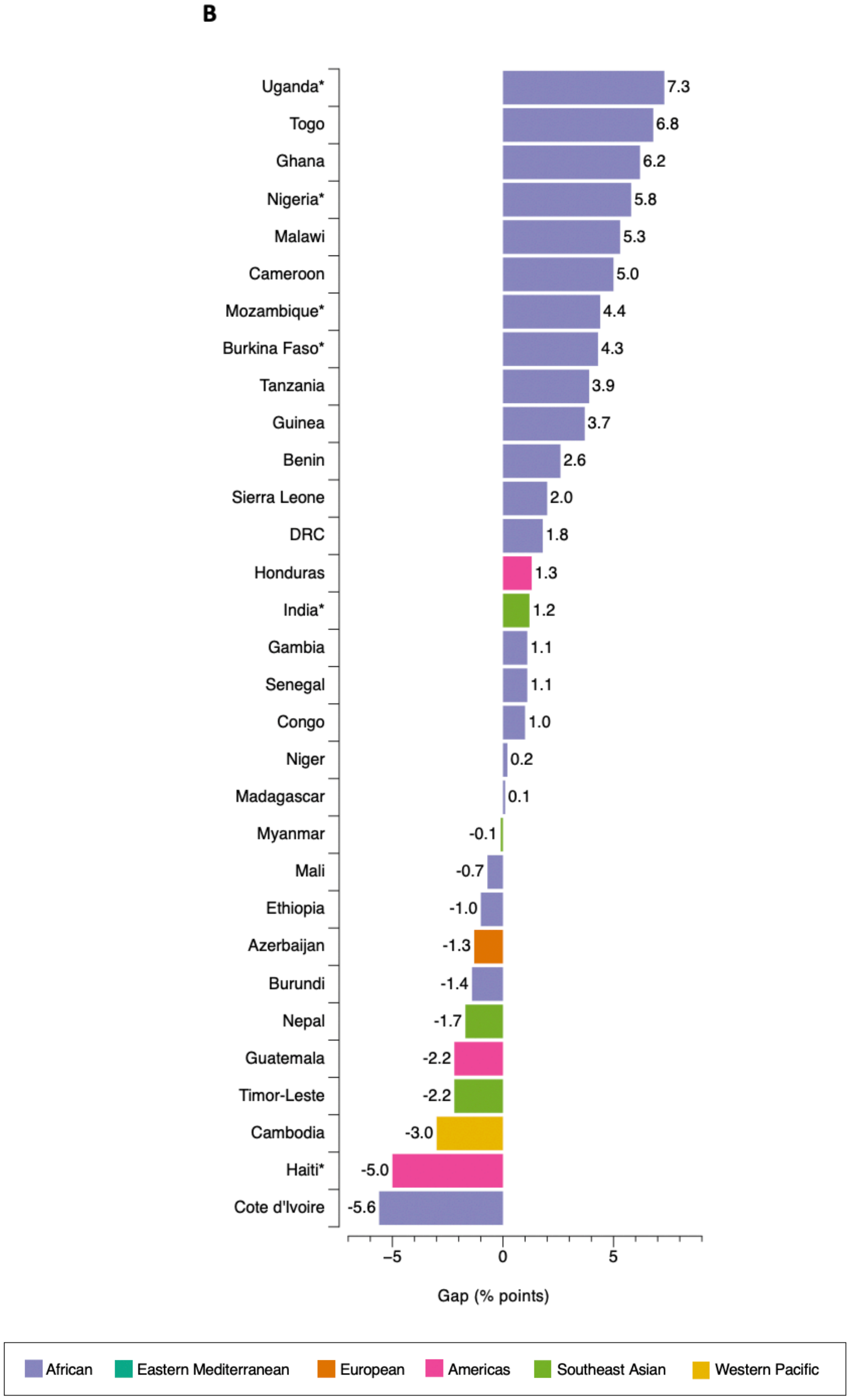
Note: Q1: poorest; Q2: poorer; Q3: middle; Q4: richer; Q5: richest; E1: no education; E2: primary education; E3+: secondary or higher education; AFRO, African region; EMRO, Eastern Mediterranean region; EURO, European region, PAHO, Americas region; SEARO, Southeast Asian region. The WPRO (Western Pacific region) is missing because there was only one country with available data (Cambodia), and thus, the regional pooled prevalence could not be calculated. The pooled prevalence is also missing for the Eastern Mediterranean (by wealth quintile and education level) and the European region (by education level) due to sample sizes <25 observations.

Figure 5.6. Absolute gap difference of concurrent overweight/obesity and anaemia by wealth quintile (A), education level (B) and area of residence (C) among adolescent girls.



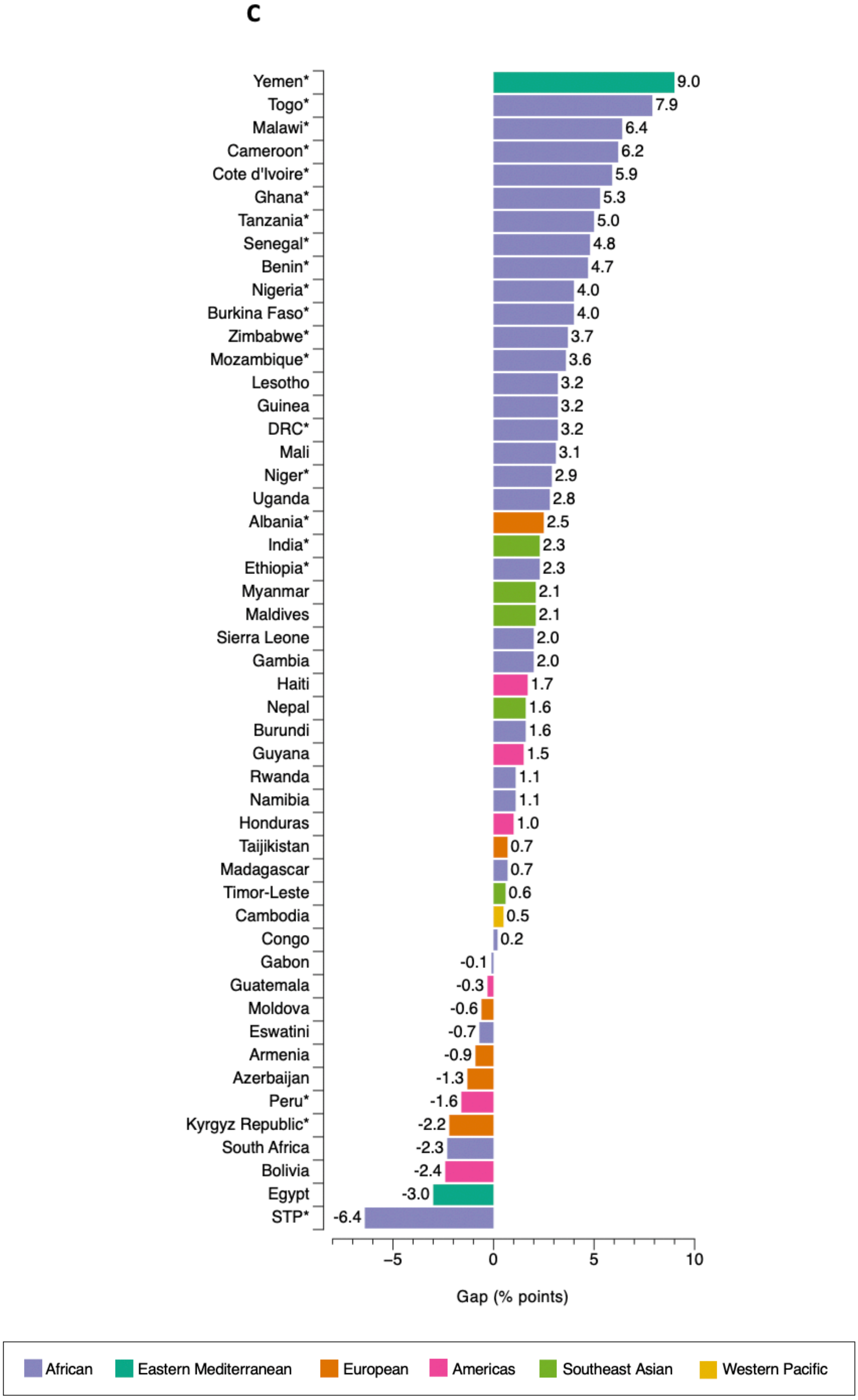
Note: Positive values mean that concurrent overweight/obesity and anaemia is more prevalent in the richest quintile (Q5), highest education level (E3) and in urban areas when compared to the poorest quintile (Q1), lowest education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. Countries with a sample size <25 observations were excluded. In figure B, Yemen was not included because data on education level was missing. DRC: Democratic of the Congo; STP: Sao Tome and Principe.

Figure 5.6. (continued)



Note: Positive values mean that concurrent overweight/obesity and anaemia is more prevalent in the richest quintile (Q5), highest education level (E3) and in urban areas when compared to the poorest quintile (Q1), lowest education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. Countries with a sample size <25 observations were excluded. In figure B, Yemen was not included because data on education level was missing. DRC: Democratic of the Congo; STP: Sao Tome and Principe.

Figure 5.6. (continued)



Note: Positive values mean that concurrent overweight/obesity and anaemia is more prevalent in the richest quintile (Q5), highest education level (E3) and in urban areas when compared to the poorest quintile (Q1), lowest education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. Countries with a sample size <25 observations were excluded. In figure B, Yemen was not included because data on education level was missing. DRC: Democratic of the Congo; STP: Sao Tome and Principe.

5.2.4. Overweight/obesity and anaemia among children

The pooled prevalence of concurrent overweight/obesity and anaemia among children was 3.0% (95% CI: 2.7, 3.3; I^2: 97.1%), ranging from 0.4% in Nepal to 9.1% in South Africa (**Figure 5.2** and **Table 5.12**). The pooled regional prevalence ranged from 1.2% (95% CI: 0.8, 1.7) in the Southeast Asian region to 3.8% (95% CI: 2.4, 5.2) in the European region. The full distribution of concurrent overweight/obesity and anaemia among children by sociodemographic characteristics (including sex) is presented in **Tables 5.13, 5.14, 5.15** and **5.16**.

Table 5.12. Prevalence of overweight/obesity, anaemia, and concurrent overweight/obesity and anaemia among children.

	Children (6-59 months)*		
Country and survey year	**OWOB**	**Anaemia**	**DBM**
AFRICAN REGION			
Regional prevalence	**5.8 [4.9, 6.6]**	**64.3 [59.9, 68.6]**	**3.3 [2.8, 3.8]**
Angola 2015-16	4.1 [3.4, 4.9]	65.1 [62.7, 67.3]	2.3 [1.8, 2.9]
Benin 2017-18	2.0 [1.7, 2.3]	71.6 [70.0, 73.2]	1.3 [1.0, 1.7]
Burkina Faso 2010	3.1 [2.6, 3.7]	87.7 [86.6, 88.7]	2.9 [2.4, 3.6]
Burundi 2016-17	1.8 [1.5, 2.3]	60.4 [58.6, 62.3]	1.0 [0.8, 1.4]
Cameroon 2011	8.3 [7.4, 9.3]	61.6 [59.2, 63.1]	4.5 [3.8, 5.2]
Congo 2011-12	3.9 [3.0, 5.1]	67.2 [64.4, 69.9]	2.7 [2.0, 3.7]
Cote d'Ivoire 2011-12	3.9 [3.1, 4.8]	75.5 [73.4, 77.5]	2.9 [2.2, 3.7]
DRC 2013-14	4.8 [4.1, 5.6]	59.8 [57.6, 62.0]	2.4 [2.0, 3.0]
Eswatini 2006-07	14.2 [12.6, 15.9]	42.3 [39.2, 45.4]	7.0 [6.0, 8.1]
Ethiopia 2016	2.9 [2.4, 3.6]	57.0 [54.5, 59.5]	1.3 [1.0, 1.8]
Gabon 2012	9.2 [7.4, 11.3]	61.2 [58.4, 64.0]	6.0 [4.6, 7.8]
Gambia 2013	2.7 [2.1, 3.5]	73.0 [70.0, 75.7]	1.6 [1.1, 2.4]
Ghana 2014	2.8 [2.1, 3.8]	66.7 [63.6, 69.7]	1.9 [1.4, 2.7]
Guinea 2018	6.3 [5.3, 7.4]	75.1 [73.1, 77.0]	4.7 [3.8, 5.9]
Lesotho 2014	9.5 [8.0, 11.4]	54.2 [49.9, 58.4]	4.4 [3.2, 5.9]

*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

We used the most recent dataset available for each country. Estimates were not calculated or are missing for that country due to i) data not available for one or more age groups (i.e., Angola) or ii) children's anthropometric measures were unreliable in the most recent survey (i.e., Jordan and Madagascar).

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity; DBM, concurrent overweight/obesity and anaemia.

Table 5.12. (continued)

	Children (6-59 months)*		
Country and survey year	**OWOB**	**Anaemia**	**DBM**
AFRICAN REGION			
Madagascar 2003-04	5.5 [4.2, 7.2]	68.3 [64.2, 72.2]	3.1 [1.9, 5.0]
Malawi 2015-16	5.3 [4.5, 6.2]	63.0 [61.0, 65.0]	3.3 [2.8, 4.0]
Mali 2018	2.0 [1.7, 2.4]	82.4 [80.8, 83.9]	1.6 [1.2, 2.1]
Mozambique 2011	9.4 [8.5, 10.3]	68.7 [66.4, 70.8]	6.1 [5.2, 7.0]
Namibia 2013	5.1 [4.1, 6.4]	49.2 [46.1, 52.2]	2.4 [1.6, 3.4]
Niger 2012	2.8 [2.2, 3.5]	73.0 [71.0, 74.9]	1.7 [1.2, 2.3]
Nigeria 2018	2.4 [2.1, 2.8]	67.9 [66.4, 69.3]	1.5 [1.2, 1.8]
Rwanda 2014-15	10.9 [9.9, 12.0]	36.5 [34.5, 38.5]	3.3 [2.7, 4.0]
STP 2008-09	13.2 [11.1, 15.7]	63.3 [59.6, 66.8]	8.6 [6.9, 10.5]
Senegal 2010-11	2.9 [2.2, 3.7]	77.1 [74.8, 79.3]	1.7 [1.2, 2.4]
Sierra Leone 2013	9.9 [8.7, 11.3]	80.1 [78.3, 81.7]	8.0 [6.8, 9.4]
South Africa 2016	15.7 [12.9, 18.9]	62.3 [57.6, 66.8]	9.1 [6.7, 12.1]
Tanzania 2015-16	4.8 [4.3, 5.4]	58.6 [56.9, 60.2]	2.8 [2.4, 3.3]
Togo 2013-14	2.1 [1.6, 2.8]	70.8 [68.6, 72.9]	1.6 [1.2, 2.3]
Uganda 2016	5.0 [4.3, 5.7]	53.6 [51.3, 55.9]	2.6 [2.1, 3.3]
Zimbabwe 2015	6.8 [6.0, 7.7]	38.2 [36.3, 40.1]	2.5 [2.0, 3.2]
EASTERN MEDITERRANEAN REGION			
Regional prevalence	**7.3 [0.6, 14.1]**	**49.7 [10.0, 89.3]**	**2.5 [1.3, 3.7]**
Egypt 2014	16.9 [15.8, 17.9]	27.8 [25.9, 29.8]	4.6 [3.8, 5.5]
Jordan 2012	4.6 [3.8, 5.5]	32.2 [29.8, 34.6]	1.4 [1.0, 2.1]
Yemen 2013	2.4 [2.1, 2.8]	86.0 [84.4, 87.5]	2.0 [1.5, 2.6]
EUROPEAN REGION			
Regional prevalence	**12.1 [7.5, 16.7]**	**32.6 [24.3, 40.9]**	**3.8 [2.4, 5.2]**
Albania 2017-18	18.0 [16.0, 20.2]	24.1 [21.6, 26.8]	4.3 [3.3, 5.6]
Armenia 2015-16	14.7 [12.4, 17.2]	15.8 [13.7, 18.2]	3.3 [2.3, 4.6]

*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

We used the most recent dataset available for each country. Estimates were not calculated or are missing for that country due to i) data not available for one or more age groups (i.e., Angola) or ii) children's anthropometric measures were unreliable in the most recent survey (i.e., Jordan and Madagascar).

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity; DBM, concurrent overweight/obesity and anaemia.

Table 5.12. (continued)

	Children (6-59 months)*		
Country and survey year	**OWOB**	**Anaemia**	**DBM**
EUROPEAN REGION			
Azerbaijan 2006	14.8 [12.8, 16.9]	37.5 [34.0, 41.2]	5.2 [4.0, 6.7]
Kyrgyz Republic 2012	10.3 [9.1, 11.7]	43.2 [40.6, 45.8]	5.0 [4.2, 6.0]
Moldova 2005	10.1 [8.4, 12.1]	33.1 [30.2, 36.2]	3.1 [2.0, 4.7]
Tajikistan 2017	4.0 [3.4, 4.7]	41.6 [39.3, 43.9]	1.8 [1.3, 2.1]
AMERICAS REGION			
Regional prevalence	**6.6 [5.0, 8.3]**	**44.0 [32.5, 55.4]**	**2.7 [1.9, 3.5]**
Bolivia 2008	11.3 [10.4, 12.2]	60.7 [57.9, 63.5]	6.7 [5.5, 8.2]
Guatemala 2014-15	5.1 [4.6, 5.5]	32.7 [31.4, 34.2]	1.2 [1.0, 1.5]
Guyana 2009	7.1 [5.5, 9.1]	38.9 [35.2, 42.7]	2.8 [1.8, 4.1]
Haiti 2016-17	3.9 [3.3, 4.5]	66.8 [64.8, 68.8]	2.3 [1.9, 2.9]
Honduras 2011-12	5.7 [5.1, 6.3]	29.2 [27.9, 30.6]	1.3 [1.0, 1.7]
Peru 2012	8.3 [7.4, 9.2]	32.2 [30.8, 33.7]	2.5 [2.1, 3.0]
SOUTHEAST ASIAN REGION			
Regional prevalence	**3.1 [2.0, 4.1]**	**50.2 [44.6, 55.8]**	**1.2 [0.8, 1.7]**
India 2015-16	2.2 [2.1, 2.3]	58.1 [57.7, 58.5]	1.2 [1.1, 1.2]
Maldives 2016-17	4.7 [3.8, 5.8]	50.8 [47.9, 53.7]	1.8 [1.2, 2.8]
Myanmar 2015-16	1.5 [1.1, 2.1]	59.0 [56.7, 61.2]	1.0 [0.7, 1.6]
Nepal 2016	1.1 [0.7, 1.6]	51.9 [49.2, 54.7]	0.4 [0.2, 0.9]
Timor-Leste 2016	4.8 [4.1, 5.5]	40.4 [37.2, 43.8]	1.7 [1.0, 2.7]
WESTERN PACIFIC REGION			
Regional prevalence	**-**	**-**	**-**
Cambodia 2014	2.3 [1.8, 3.0]	56.4 [54.3, 58.6]	1.4 [0.9, 2.0]
OVERALL POOLED PREVALENCE	**6.3 [5.7, 7.0]**	**55.9 [51.7, 60.1]**	**3.0 [2.7, 3.3]**

*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
We used the most recent dataset available for each country. Estimates were not calculated or are missing for that country due to i) data not available for one or more age groups (i.e., Angola) or ii) children's anthropometric measures were unreliable in the most recent survey (i.e., Jordan and Madagascar).
DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity; DBM, concurrent overweight/obesity and anaemia.

Table 5.13. Concurrent overweight/obesity and anaemia by household wealth quintiles among children (6-59 months).

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
Regional prevalence	**2.9 [2.4, 3.5]**	**3.2 [2.6, 3.8]**	**3.1 [2.6, 3.7]**	**2.9 [2.4, 3.4]**	**3.4 [2.8, 4.0]**	**0.5**	-
Angola 2015-16	1.7 [1.0, 2.7]	2.2 [1.5, 3.1]	2.8 [1.8, 4.4]	2.4 [1.2, 4.8]	2.5 [1.2, 5.1]	0.8	0.7338
Benin 2017-18	0.8 [0.4, 1.7]	1.6 [1.0, 2.7]	1.9 [1.2, 3.1]	1.1 [0.6, 2.0]	1.0 [0.6, 1.9]	0.2	0.1803
Burkina Faso 2010	2.6 [1.6, 4.2]	3.4 [2.5, 4.7]	2.9 [2.0, 4.2]	3.1 [2.1, 4.6]	2.3 [1.4, 3.8]	-0.3	0.7464
Burundi 2016-17	1.3 [0.7, 2.2]	1.0 [0.5, 1.9]	1.1 [0.7, 2.0]	1.0 [0.5, 1.8]	0.7 [0.3, 1.4]	-0.6	0.8054
Cameroon 2011	2.8 [1.9, 4.1]	5.1 [3.7, 6.9]	5.9 [4.2, 8.1]	4.6 [3.3, 6.4]	4.0 [2.7, 5.8]	1.2	0.0470
Congo 2011-12	2.0 [1.3, 3.2]	2.4 [1.2, 4.8]	2.9 [1.3, 6.3]	2.8 [1.3, 5.7]	4.1 [2.1, 7.8]	2.1	0.6130
Cote d'Ivoire 2011-12	3.0 [1.7, 5.3]	3.2 [1.9, 5.1]	2.5 [1.3, 4.8]	2.3 [1.1, 4.7]	3.3 [1.5, 7.2]	0.3	0.9374
DRC 2013-14	2.9 [2.0, 4.4]	2.9 [1.9, 4.3]	2.1 [1.4, 3.2]	1.9 [1.2, 3.0]	2.2 [1.4, 3.4]	-0.7	0.4430
Eswatini 2006-07	6.9 [5.0, 9.6]	7.6 [5.6, 10.3]	7.9 [5.7, 10.8]	6.0 [4.0, 8.8]	6.3 [4.8, 8.1]	-0.6	0.8224
Ethiopia 2016	1.3 [0.7, 2.3]	0.6 [0.2, 1.4]	0.9 [0.5, 1.8]	2.6 [1.6, 4.3]	1.8 [0.9, 3.5]	0.5	0.0086
Gabon 2012	5.5 [4.1, 7.3]	5.9 [3.6, 9.7]	3.9 [2.0, 7.3]	6.3 [3.0, 12.6]	9.0 [4.4, 17.8]	3.5	0.3986

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.13. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
Gambia 2013	1.3 [0.6, 2.8]	1.2 [0.5, 2.8]	2.3 [1.3, 3.9]	1.6 [0.6, 4.6]	1.9 [0.6, 5.5]	0.6	0.7995
Ghana 2014	1.9 [1.1, 3.2]	2.2 [1.1, 4.1]	2.0 [1.0, 4.2]	1.3 [0.5, 3.3]	2.2 [0.8, 5.8]	0.3	0.9207
Guinea 2018	4.6 [3.0, 6.9]	3.8 [2.6, 5.6]	5.2 [3.3, 8.2]	2.9 [1.6, 5.3]	7.8 [5.0, 11.8]	3.2	0.0448
Lesotho 2014	5.2 [3.2, 8.3]	5.6 [3.1, 10.0]	4.6 [2.1, 9.8]	2.6 [1.1, 6.4]	3.6 [1.3, 9.3]	-1.6	0.6676
Madagascar 2003-04	2.2 [0.9, 5.4]	5.8 [3.9, 8.5]	2.2 [0.4, 10.9]	1.9 [1.1, 3.1]	3.6 [2.3, 5.5]	1.4	0.2637
Malawi 2015-16	2.6 [1.7, 4.0]	4.6 [3.2, 6.6]	3.9 [2.6, 5.7]	2.6 [1.6, 4.2]	2.7 [1.7, 4.5]	0.1	0.1434
Mali 2018	0.8 [0.3, 2.2]	1.8 [0.9, 3.4]	1.4 [0.7, 3.0]	2.4 [1.5, 4.0]	1.4 [0.7, 2.7]	0.6	0.3346
Mozambique 2011	5.5 [3.9, 7.7]	6.6 [5.0, 8.7]	6.6 [4.8, 9.1]	6.0 [4.4, 8.1]	5.5 [4.1, 7.4]	0.0	0.8553
Namibia 2013	1.0 [0.4, 2.9]	2.4 [1.0, 5.7]	2.4 [1.2, 4.9]	2.8 [1.3, 5.9]	4.2 [1.7, 10.2]	3.2	0.3357
Niger 2012	1.5 [0.8, 2.8]	1.1 [0.4, 2.9]	2.0 [1.0, 4.1]	1.6 [0.9, 3.0]	2.1 [1.2, 3.8]	0.6	0.7206
Nigeria 2018	1.7 [1.1, 2.6]	2.2 [1.2, 3.0]	1.4 [1.0, 2.0]	1.6 [1.0, 2.6]	0.6 [0.3, 1.1]	-1.1	0.0122
Rwanda 2014-15	3.5 [2.3, 5.3]	3.3 [2.2, 5.0]	2.4 [1.3, 4.3]	3.9 [2.6, 5.9]	3.4 [2.0, 5.8]	-0.1	0.7526

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.13. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
STP 2008-09	10.5 [7.0, 15.3]	8.3 [5.2, 12.9]	7.4 [4.5, 12.1]	6.8 [3.7, 12.2]	10.6 [6.2, 17.4]	0.1	0.6277
Senegal 2010-11	2.3 [1.5, 3.6]	1.4 [0.8, 2.7]	1.7 [0.9, 3.3]	2.0 [0.7, 5.0]	1.0 [0.2, 3.9]	-1.3	0.6865
Sierra Leone 2013	11.0 [8.4, 14.2]	7.5 [5.4, 10.3]	6.7 [4.9, 9.1]	7.7 [5.6, 10.4]	6.0 [3.8, 9.3]	-5.0	0.0566
South Africa 2016	13.1 [8.0, 20.8]	10.6 [5.8, 18.7]	7.7 [3.8, 14.9]	4.6 [2.4, 8.9]	5.8 [2.2, 14.2]	-7.3	0.1903
Tanzania 2015-16	2.4 [1.8, 3.4]	2.6 [1.7, 4.0]	3.0 [2.1, 4.3]	2.4 [1.7, 3.6]	3.9 [2.8, 5.4]	1.5	0.3236
Togo 2013-14	1.4 [0.8, 2.6]	1.5 [0.7, 3.0]	2.1 [0.9, 4.5]	1.3 [0.5, 3.4]	2.0 [0.9, 4.3]	0.6	0.8681
Uganda 2016	3.3 [1.8, 5.8]	4.0 [2.3, 6.7]	3.9 [2.3, 6.6]	4.1 [2.1, 7.9]	12.8 [8.7, 18.5]	9.5	0.8914
Zimbabwe 2015	2.3 [1.4, 3.6]	1.6 [0.8, 3.1]	2.2 [1.3, 3.7]	2.8 [1.8, 4.4]	4.1 [2.6, 6.6]	1.8	0.1008
EASTERN MEDITERRANEAN REGION							
Regional prevalence	**2.7 [1.1, 4.2]**	**2.5 [1.4, 3.5]**	**2.2 [1.2, 3.1]**	**2.8 [1.1, 4.6]**	**2.2 [1.2, 3.1]**	**-0.5**	**-**
Egypt 2014	5.8 [4.0, 8.5]	4.3 [2.9, 6.3]	3.6 [2.4, 5.3]	5.1 [3.5, 7.4]	4.2 [2.7, 6.5]	-1.6	0.4221
Jordan 2012	2.2 [1.1, 4.5]	1.7 [0.9, 3.5]	0.9 [0.5, 1.5]	0.4 [0.2, 0.8]	1.7 [0.5, 5.6]	-0.5	0.1418

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.13. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
EASTERN MEDITERRANEAN REGION							
Yemen 2013	1.4 [0.8, 2.7]	2.0 [1.1, 3.4]	2.1 [1.2, 3.7]	3.5 [2.2, 5.6]	1.0 [0.5, 2.2]	-0.4	0.0506
EUROPEAN REGION							
Regional prevalence	**3.7 [2.2, 5.2]**	**4.2 [2.9, 5.5]**	**3.8 [2.3, 5.3]**	**3.3 [2.0, 4.6]**	**3.3 [1.5, 5.1]**	**-0.4**	**-**
Albania 2017-18	5.5 [3.8, 8.0]	5.8 [3.5, 9.5]	4.5 [2.5, 7.9]	2.3 [1.2, 4.6]	2.3 [0.4, 11.4]	-3.2	0.2873
Armenia 2015-16	1.5 [0.5, 3.9]	4.2 [2.1, 8.2]	4.5 [2.3, 8.5]	2.3 [1.0, 5.2]	3.9 [1.7, 8.5]	2.4	0.3759
Azerbaijan 2006	4.2 [2.8, 6.1]	6.0 [4.1, 8.6]	6.3 [4.3, 9.1]	4.8 [2.5, 9.1]	4.7 [2.5, 8.6]	0.5	0.8088
Kyrgyz Republic 2012	5.2 [3.4, 7.8]	4.5 [3.2, 6.4]	4.6 [3.3, 6.3]	5.7 [3.6, 8.8]	5.1 [3.2, 8.0]	-0.1	0.9065
Moldova 2005	2.8 [1.1, 6.7]	3.8 [1.5, 9.5]	2.3 [1.1, 4.5]	2.3 [0.9, 5.3]	4.4 [2.1, 9.0]	1.6	0.7294
Tajikistan 2017	1.4 [0.8, 2.3]	1.9 [1.1, 3.2]	2.0 [1.2, 3.3]	1.8 [1.1, 2.8]	1.1 [0.6, 2.2]	-0.3	0.5898

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.13. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AMERICAS REGION							
Regional prevalence	**2.1 [1.5, 2.8]**	**2.6 [1.6, 3.6]**	**2.5 [1.7, 3.4]**	**2.3 [1.5, 3.1]**	**2.3 [1.3, 3.2]**	**0.2**	**-**
Bolivia 2008	7.6 [5.4, 10.6]	9.9 [6.7, 14.4]	4.3 [2.6, 6.9]	5.4 [3.2, 8.9]	5.7 [3.1, 10.1]	-1.9	0.0488
Guatemala 2014-15	1.5 [1.0, 2.2]	1.3 [0.9, 1.8]	1.1 [0.7, 1.8]	1.0 [0.6, 1.6]	1.0 [0.5, 1.9]	-0.5	0.6273
Guyana 2009	1.8 [1.0, 3.5]	1.6 [0.5, 4.6]	4.8 [2.3, 9.6]	4.7 [1.7, 12.2]	1.8 [0.5, 5.9]	0.0	0.1610
Haiti 2016-17	2.2 [1.5, 3.3]	2.4 [1.6, 3.5]	2.9 [1.9, 4.5]	1.8 [0.9, 3.3]	2.4 [1.3, 4.5]	0.2	0.7170
Honduras 2011-12	1.4 [1.0, 2.0]	1.0 [0.6, 1.7]	2.0 [1.0, 4.0]	1.2 [0.7, 2.1]	0.8 [0.4, 1.5]	-0.6	0.2598
Peru 2012	1.8 [1.3, 2.5]	2.0 [1.4, 2.9]	2.7 [1.9, 3.9]	3.3 [2.1, 5.1]	3.1 [1.6, 5.8]	1.3	0.2448
SOUTHEAST ASIAN REGION							
Regional prevalence	**1.1 [0.6, 1.6]**	**1.1 [1.0, 1.1]**	**1.1 [0.7, 1.6]**	**1.0 [0.3, 1.7]**	**1.5 [0.6, 2.5]**	**0.4**	**-**
India 2015-16	0.9 [0.8, 1.0]	0.9 [0.8, 1.0]	1.2 [1.0, 1.4]	1.4 [1.2, 1.6]	1.7 [1.4, 2.0]	0.8	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.13. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION							
Maldives 2016-17	2.2 [1.3, 3.7]	1.6 [0.8, 3.2]	1.5 [0.7, 3.1]	3.1 [0.9, 10.0]	0.0 [0.0, 0.0]	-2.2	0.3545
Myanmar 2015-16	0.6 [0.3, 1.5]	1.2 [0.4, 3.2]	1.2 [0.5, 3.0]	0.4 [0.1, 2.0]	2.3 [1.0, 5.3]	1.7	0.2026
Nepal 2016	0.2 [0.0, 1.2]	0.6 [0.2, 1.8]	0.6 [0.1, 2.6]	0.2 [0.0, 1.7]	0.4 [0.1, 3.0]	0.2	0.8155
Timor-Leste 2016	2.5 [1.1, 5.5]	0.4 [0.1, 1.9]	1.1 [0.4, 3.3]	1.5 [0.4, 6.1]	2.7 [1.2, 6.1]	0.2	0.3088
WESTERN PACIFIC REGION							
Regional prevalence	-	-	-	-	-	-	-
Cambodia 2014	0.8 [0.4, 1.8]	2.2 [1.3, 3.8]	1.0 [0.4, 2.3]	1.3 [0.5, 3.3]	1.7 [0.5, 5.3]	0.9	0.4137
OVERALL POOLED PREVALENCE	**2.6 [2.3, 2.9]**	**2.8 [2.5, 3.2]**	**2.7 [2.4, 3.0]**	**2.6 [2.2, 2.9]**	**2.8 [2.4, 3.1]**	**0.2**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest household wealth quintile (%Q5 - %Q1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 5.14. Concurrent overweight/obesity and anaemia by education level (maternal) among children (6-59 months).

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AFRICAN REGION						
Regional prevalence	**2.8 [2.3, 3.4]**	**3.0 [2.5, 3.6]**	**3.1 [2.5, 3.7]**	**3.5 [2.3, 4.7]**	**0.7**	**-**
Angola 2015-16	2.4 [1.6, 3.5]	2.6 [1.8, 3.7]	2.0 [1.2, 3.2]	1.7 [0.2, 12.1]	-0.7	0.8348
Benin 2017-18	1.2 [0.9, 1.7]	1.2 [0.7, 2.1]	1.6 [0.9, 2.9]	3.5 [1.9, 6.6]	2.3	0.4241
Burkina Faso 2010¶	2.9 [2.3, 3.6]	3.3 [2.1, 5.4]	2.4 [1.0, 5.4]	-	-	-
Burundi 2016-17	0.9 [0.6, 1.4]	1.3 [0.9, 1.9]	0.5 [0.2, 1.4]	0.0 [0.0, 0.0]	-0.9	0.4037
Cameroon 2011	2.3 [1.4, 3.7]	5.1 [4.1, 6.2]	5.4 [4.1, 7.1]	5.6 [2.7, 11.1]	3.3	0.0046
Congo 2011-12	2.1 [0.6, 7.5]	2.8 [1.8, 4.3]	2.8 [1.8, 4.2]	2.6 [0.5, 13.0]	0.5	0.9732
Cote d'Ivoire 2011-12¶	3.1 [2.2, 4.4]	2.6 [1.5, 4.4]	1.4 [0.3, 6.5]	-	-	-
DRC 2013-14	2.4 [1.5, 3.7]	2.3 [1.7, 3.1]	2.8 [2.0, 3.7]	0.0 [0.0, 0.0]	-2.4	0.6201
Eswatini 2006-07	4.7 [2.6, 8.2]	7.5 [5.7, 10.0]	7.0 [5.4, 9.1]	6.9 [3.9, 11.9]	2.2	0.6856

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest maternal education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by Maternal education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Burkina Faso, Cote d' Ivoire, Lesotho, Sao Tome and Principe, Senegal, South Africa, Albania, Armenia, Azerbaijan, Kyrgyz Republic, Moldova due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the European region could not be calculated.

Table 5.14. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AFRICAN REGION						
Ethiopia 2016	1.1 [0.7, 1.6]	1.9 [1.2, 3.1]	0.9 [0.4, 2.0]	3.2 [0.6, 15.1]	2.1	0.0932
Gabon 2012	7.7 [3.0, 18.4]	5.2 [3.7, 7.3]	6.1 [4.2, 8.9]	5.8 [1.5, 20.2]	-1.9	0.8773
Gambia 2013	1.2 [0.7, 1.9]	1.7 [0.7, 3.9]	2.7 [1.2, 5.8]	2.1 [1.1, 3.9]	0.9	0.1817
Ghana 2014	1.8 [1.1, 3.1]	1.7 [0.9, 3.4]	2.1 [1.2, 3.6]	1.7 [0.2, 12.1]	-0.1	0.9576
Guinea 2018	4.0 [3.1, 5.1]	6.3 [3.7, 10.5]	8.2 [4.7, 13.8]	6.1 [2.2, 15.6]	2.1	0.0260
Lesotho 2014¶	-	3.6 [2.4, 5.5]	4.4 [2.6, 7.2]	9.4 [3.7, 21.8]	-	-
Madagascar 2003-04	3.5 [2.1, 5.9]	2.9 [1.5, 5.6]	2.8 [2.0, 4.0]	11.4 [2.9, 35.7]	7.9	0.4658
Malawi 2015-16	3.5 [2.1, 5.8]	3.5 [2.8, 4.3]	3.1 [1.9, 4.9]	0.7 [0.4, 1.3]	-2.8	0.5332
Mali 2018	1.7 [1.2, 2.4]	1.0 [0.4, 3.0]	1.4 [0.6, 2.9]	0.9 [0.6, 1.2]	-0.8	0.6340
Mozambique 2011	7.0 [5.6, 8.7]	5.7 [4.6, 7.0]	5.1 [3.4, 7.7]	0.0 [0.0, 0.0]	-7.0	0.2380

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest maternal education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by Maternal education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Burkina Faso, Cote d' Ivoire, Lesotho, Sao Tome and Principe, Senegal, South Africa, Albania, Armenia, Azerbaijan, Kyrgyz Republic, Moldova due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the European region could not be calculated.

Table 5.14. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AFRICAN REGION						
Namibia 2013	1.5 [0.3, 5.9]	2.1 [1.0, 4.2]	2.4 [1.5, 3.9]	3.9 [1.1, 13.0]	2.4	0.7393
Niger 2012	1.7 [1.2, 2.4]	1.3 [0.6, 3.2]	1.8 [0.6, 5.3]	3.3 [0.5, 20.2]	1.6	0.8513
Nigeria 2018	1.8 [1.4, 2.4]	1.5 [0.9, 2.3]	1.5 [1.1, 2.0]	0.3 [0.1, 1.2]	-1.5	0.0259
Rwanda 2014-15	3.8 [2.3, 6.0]	3.2 [2.5, 4.1]	3.8 [2.1, 6.7]	1.1 [0.1, 8.1]	-2.7	0.6448
STP 2008-09¶	11.8 [5.2, 24.6]	8.3 [6.5, 10.5]	8.9 [5.8, 13.6]	-	-	-
Senegal 2010-11¶	2.1 [1.5, 3.0]	0.6 [0.2, 1.5]	1.4 [0.2, 9.4]	-	-	-
Sierra Leone 2013	8.4 [7.0, 9.9]	5.5 [3.4, 9.0]	7.3 [5.0, 10.5]	21.4 [8.5, 44.4]	13.0	0.0278
South Africa 2016¶	-	17.5 [8.2, 33.4]	9.1 [6.6, 12.4]	1.7 [0.4, 7.4]	-	-
Tanzania 2015-16	2.8 [2.0, 3.9]	2.6 [2.1, 3.2]	3.8 [2.6, 5.5]	6.0 [1.5, 20.6]	3.2	0.2491
Togo 2013-14	1.4 [0.8, 2.3]	1.9 [1.1, 3.3]	1.7 [0.8, 3.3]	2.2 [0.3, 16.4]	0.8	0.7938

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest maternal education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by Maternal education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Burkina Faso, Cote d' Ivoire, Lesotho, Sao Tome and Principe, Senegal, South Africa, Albania, Armenia, Azerbaijan, Kyrgyz Republic, Moldova due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the European region could not be calculated.

Table 5.14. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AFRICAN REGION						
Uganda 2016	5.4 [3.0, 9.7]	4.5 [3.4, 6.1]	8.9 [5.1, 15.0]	6.4 [3.3, 12.0]	1.0	0.7791
Zimbabwe 2015	4.9 [0.7, 26.7]	2.1 [1.4, 3.3]	2.5 [1.9, 3.3]	4.6 [2.1, 9.9]	-0.3	0.3406
EASTERN MEDITERRANEAN REGION						
Regional prevalence	**3.3 [2.1, 4.5]**	**3.3 [2.1, 4.6]**	**1.9 [1.5, 2.2]**	**2.2 [1.6, 2.8]**	**-1.1**	**-**
Egypt 2014	3.1 [2.0, 4.9]	5.9 [3.6, 9.5]	4.8 [3.7, 6.2]	4.5 [2.9, 6.8]	1.4	0.3038
Jordan 2012	1.8 [0.5, 6.6]	1.4 [0.6, 3.4]	1.5 [0.8, 2.5]	1.3 [0.7, 2.1]	-0.5	0.9362
Yemen 2013§	-	-	-	-	-	-
EUROPEAN REGION						
Regional prevalence	**-**	**-**	**-**	**-**	**-**	**-**
Albania 2017-18¶	-	5.9 [4.2, 8.2]	3.5 [2.1, 5.6]	2.1 [1.1, 3.8]	-	-

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest maternal education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by Maternal education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Burkina Faso, Cote d' Ivoire, Lesotho, Sao Tome and Principe, Senegal, South Africa, Albania, Armenia, Azerbaijan, Kyrgyz Republic, Moldova due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the European region could not be calculated.

Table 5.14. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
EUROPEAN REGION						
Armenia 2015-16¶	-	2.2 [0.5, 9.7]	3.3 [1.9, 5.7]	3.4 [2.0, 5.7]	-	-
Azerbaijan 2006¶	-	0.0 [0.0, 0.0]	5.3 [4.1, 6.9]	3.8 [1.8, 7.9]	-	-
Kyrgyz Republic 2012¶	-	-	5.4 [4.3, 6.7]	4.6 [3.5, 6.0]	-	-
Moldova 2005¶	-	-	3.1 [2.0, 4.7]	3.3 [2.1, 5.3]	-	-
Tajikistan 2017	1.0 [0.2, 3.9]	1.8 [0.7, 4.3]	1.7 [1.4, 2.3]	1.4 [0.7, 2.7]	0.4	0.8131
AMERICAS REGION						
Regional prevalence	**1.8 [1.2, 2.4]**	**2.7 [1.8, 3.5]**	**2.4 [1.6, 3.2]**	**2.1 [1.1, 3.2]**	**0.3**	-
Bolivia 2008	3.4 [1.4, 8.1]	7.9 [6.1, 10.1]	5.8 [4.1, 8.3]	4.7 [2.6, 8.5]	1.3	0.1066
Guatemala 2014-15	1.4 [0.9, 2.2]	1.2 [1.0, 1.6]	1.1 [0.7, 1.7]	1.1 [0.3, 3.9]	-0.3	0.8791
Guyana 2009	1.3 [0.2, 9.7]	1.3 [0.6, 2.9]	3.1 [2.0, 4.9]	4.7 [0.6, 28.9]	3.4	0.3931

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest maternal education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by Maternal education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Burkina Faso, Cote d' Ivoire, Lesotho, Sao Tome and Principe, Senegal, South Africa, Albania, Armenia, Azerbaijan, Kyrgyz Republic, Moldova due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the European region could not be calculated.

Table 5.14. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AMERICAS REGION						
Haiti 2016-17	2.7 [1.8, 4.1]	2.5 [1.9, 3.4]	2.0 [1.3, 2.9]	1.8 [0.3, 9.3]	-0.9	0.6602
Honduras 2011-12	1.2 [0.5, 3.1]	1.5 [1.1, 2.2]	1.0 [0.7, 1.6]	1.0 [0.5, 2.0]	-0.2	0.4465
Peru 2012	1.1 [0.3, 3.8]	2.4 [1.7, 3.4]	2.6 [2.0, 3.4]	2.6 [1.6, 4.0]	1.5	0.6896
SOUTHEAST ASIAN REGION						
Regional prevalence	**1.1 [0.5, 1.7]**	**1.0 [0.7, 1.3]**	**1.3 [0.9, 1.6]**	**1.9 [1.7, 2.1]**	**0.8**	**-**
India 2015-16	0.9 [0.8, 1.0]	1.0 [0.9, 1.2]	1.2 [1.1, 1.3]	1.7 [1.4, 2.1]	0.8	0.0000
Maldives 2016-17	2.9 [0.3, 23.1]	1.5 [0.7, 3.2]	2.0 [1.1, 3.6]	1.4 [0.7, 2.8]	-1.5	0.7530
Myanmar 2015-16	0.2 [0.0, 0.6]	0.9 [0.5, 1.7]	1.4 [0.7, 3.1]	2.3 [0.9, 5.8]	2.1	0.1010

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest maternal education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by Maternal education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Burkina Faso, Cote d' Ivoire, Lesotho, Sao Tome and Principe, Senegal, South Africa, Albania, Armenia, Azerbaijan, Kyrgyz Republic, Moldova due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the European region could not be calculated.

Table 5.14. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION						
Nepal 2016	0.0 [0.0, 0.0]	0.3 [0.1, 1.6]	0.7 [0.3, 2.0]	1.2 [0.4, 3.7]	1.2	0.0612
Timor-Leste 2016	2.5 [1.3, 5.1]	0.5 [0.1, 2.1]	1.5 [0.7, 3.2]	2.6 [0.7, 9.6]	0.1	0.2660
WESTERN PACIFIC REGION						
Regional prevalence	-	-	-	-	-	-
Cambodia 2014	1.8 [0.9, 3.6]	1.4 [0.9, 2.2]	0.9 [0.4, 2.1]	3.4 [0.9, 12.4]	1.6	0.2421
OVERALL POOLED PREVALENCE	**2.4 [2.1, 2.8]**	**2.6 [2.3, 3.0]**	**2.5 [2.2, 2.8]**	**2.3 [1.8, 2.8]**	**-0.1**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within hat region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in the highest vs. the prevalence in the lowest maternal education level (%E4 - %E1).
‡ p-values were obtained through tests for trend for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by Maternal education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Missing estimates for certain categories are missing for Burkina Faso, Cote d' Ivoire, Lesotho, Sao Tome and Principe, Senegal, South Africa, Albania, Armenia, Azerbaijan, Kyrgyz Republic, Moldova due to sample size <25. These countries were excluded for the calculation of pooled estimates and, as a result, the pooled prevalence for the European region could not be calculated.

Table 5.15. Concurrent overweight/obesity and anaemia by area of residence among children (6-59 months).

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Regional prevalence	**3.5 [2.9, 4.0]**	**3.3 [2.3, 3.8]**	**0.2**	**-**
Angola 2015-16	2.6 [1.9, 3.6]	1.9 [1.4, 2.6]	0.7	0.1620
Benin 2017-18	1.0 [0.7, 1.5]	1.5 [1.1, 2.0]	-0.5	0.1406
Burkina Faso 2010	3.2 [2.1, 5.0]	2.8 [2.3, 3.6]	0.4	0.5996
Burundi 2016-17	1.0 [0.5, 2.2]	1.0 [0.8, 1.4]	0.0	0.9843
Cameroon 2011	4.7 [3.6, 5.9]	4.3 [3.5, 5.3]	0.4	0.6330
Congo 2011-12	3.1 [2.0, 4.8]	2.1 [1.6, 2.8]	1.0	0.1416
Cote d'Ivoire 2011-12	2.6 [1.5, 4.3]	3.0 [2.3, 4.1]	-0.4	0.5649
DRC 2013-14	2.1 [1.5, 2.8]	2.6 [2.0, 3.3]	-0.5	0.2598
Eswatini 2006-07	10.3 [7.9, 13.4]	6.3 [5.2, 7.6]	4.0	0.0027
Ethiopia 2016	1.8 [0.9, 3.4]	1.3 [0.9, 1.8]	0.5	0.4117
Gabon 2012	6.0 [4.3, 8.2]	5.9 [4.5, 7.9]	0.1	0.9697

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.15. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Gambia 2013	1.7 [0.9, 3.3]	1.5 [1.0, 2.4]	0.2	0.8259
Ghana 2014	2.1 [1.3, 3.6]	1.8 [1.1, 2.8]	0.3	0.5669
Guinea 2018	5.8 [3.8, 8.8]	4.3 [3.3, 5.5]	1.5	0.2165
Lesotho 2014	3.1 [1.2, 7.7]	4.9 [3.6, 6.6]	-1.8	0.3516
Madagascar 2003-04	3.4 [2.1, 5.2]	3.1 [1.7, 5.6]	0.3	0.8039
Malawi 2015-16	1.8 [0.9, 3.3]	3.6 [2.9, 4.4]	-1.8	0.0334
Mali 2018	2.0 [1.2, 3.2]	1.5 [1.0, 2.1]	0.5	0.3149
Mozambique 2011	5.9 [4.6, 7.6]	6.1 [5.1, 7.2]	-0.2	0.8329
Namibia 2013	2.8 [1.6, 5.0]	2.0 [1.3, 3.2]	0.8	0.3636
Niger 2012	2.5 [1.4, 4.7]	1.5 [1.0, 2.2]	1.0	0.1593
Nigeria 2018	1.2 [0.8, 1.7]	1.7 [1.4, 2.1]	-0.5	0.1013
Rwanda 2014-15	3.4 [2.0, 5.7]	3.3 [2.6, 4.1]	0.1	0.8813

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.15. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
STP 2008-09	7.9 [5.6, 11.0]	9.4 [7.2, 12.0]	-1.5	0.4153
Senegal 2010-11	1.8 [0.9, 3.8]	1.6 [1.1, 2.4]	0.2	0.7705
Sierra Leone 2013	7.5 [5.6, 10.0]	8.1 [6.7, 9.8]	-0.6	0.6699
South Africa 2016	8.1 [4.9, 13.0]	10.3 [7.3, 14.4]	-2.2	0.4166
Tanzania 2015-16	3.1 [2.2, 4.2]	2.8 [2.3, 3.3]	0.3	0.5621
Togo 2013-14	1.8 [1.0, 3.2]	1.6 [1.0, 2.4]	0.2	0.7835
Uganda 2016	9.2 [5.6, 14.6]	4.7 [3.6, 6.1]	4.5	0.8565
Zimbabwe 2015	3.5 [2.4, 5.0]	2.1 [1.6, 2.9]	1.4	0.0447
EASTERN MEDITERRANEAN REGION				
Regional prevalence	**2.3 [0.8, 3.7]**	**2.9 [1.8, 3.9]**	**-0.6**	**-**
Egypt 2014	4.6 [3.4, 6.3]	4.5 [3.6, 5.7]	0.1	0.9037
Jordan 2012	1.2 [0.7, 2.0]	2.4 [1.5, 3.8]	-1.2	0.0379

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.15. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
EASTERN MEDITERRANEAN REGION				
Yemen 2013	1.8 [1.0, 3.1]	2.1 [1.5, 2.8]	-0.3	0.6208
EUROPEAN REGION				
Regional prevalence	**3.3 [1.8, 4.7]**	**4.2 [2.7, 5.6]**	**-0.9**	**-**
Albania 2017-18	3.0 [1.8, 5.2]	5.8 [4.3, 7.6]	-2.8	0.0357
Armenia 2015-16	3.0 [1.8, 5.1]	3.6 [2.3, 5.7]	-0.6	0.5802
Azerbaijan 2006	5.9 [3.9, 8.9]	4.5 [3.6, 5.7]	1.4	0.2761
Kyrgyz Republic 2012	5.1 [3.6, 7.1]	5.0 [4.1, 6.1]	0.1	0.9439
Moldova 2005	2.8 [1.5, 5.0]	3.2 [1.9, 5.5]	-0.4	0.7096
Tajikistan 2017	1.3 [0.8, 2.0]	1.8 [1.4, 2.3]	-0.5	0.1823
AMERICAS REGION				
Regional prevalence	**2.4 [1.6, 3.2]**	**2.7 [1.9, 3.5]**	**-0.3**	**-**
Bolivia 2008	5.4 [3.9, 7.3]	8.4 [6.5, 10.7]	-3.0	0.0262

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.15. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AMERICAS REGION				
Guatemala 2014-15	0.9 [0.7, 1.3]	1.4 [1.1, 1.8]	-0.5	0.0670
Guyana 2009	1.7 [0.6, 4.4]	3.0 [1.9, 4.7]	-1.3	0.2666
Haiti 2016-17	1.8 [1.2, 2.7]	2.6 [2.1, 3.3]	-0.8	0.1089
Honduras 2011-12	1.4 [0.9, 2.4]	1.3 [1.0, 1.6]	0.1	0.6263
Peru 2012	2.7 [2.1, 3.4]	2.1 [1.6, 2.7]	0.6	0.1414
SOUTHEAST ASIAN REGION				
Regional prevalence	**1.2 [0.6, 1.9]**	**1.2 [0.8, 1.6]**	**0.0**	-
India 2015-16	1.4 [1.2, 1.6]	1.1 [1.0, 1.1]	0.3	0.0011
Maldives 2016-17	1.8 [0.4, 6.9]	1.8 [1.3, 2.6]	0.0	0.9674
Myanmar 2015-16	1.8 [1.0, 3.5]	0.8 [0.4, 1.5]	1.0	0.0659

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.15. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION				
Nepal 2016	0.4 [0.2, 1.0]	0.5 [0.2, 1.3]	-0.1	0.6708
Timor-Leste 2016	1.1 [0.4, 3.2]	1.9 [1.1, 3.1]	-0.8	0.4099
WESTERN PACIFIC REGION				
Regional prevalence	**-**	**-**	**-**	**-**
Cambodia 2014	1.3 [0.5, 3.1]	1.4 [0.9, 2.1]	-0.1	0.8734
OVERALL POOLED PREVALENCE	**2.9 [2.5, 3.2]**	**3.0 [2.7, 3.3]**	**-0.1**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.16. Concurrent overweight/obesity and anaemia by sex among children (6-59 months).

	Sex*			
Country and survey year	**Girls**	**Boys**	**Gap†**	**p-value‡**
AFRICAN REGION				
Regional prevalence	**2.9 [2.4, 3.3]**	**3.5 [3.0, 4.1]**	**0.6**	**-**
Angola 2015-16	1.8 [1.2, 2.7]	2.8 [2.1, 3.7]	1.0	0.0797
Benin 2017-18	1.3 [0.9, 1.9]	1.3 [0.9, 1.9]	0.0	0.9824
Burkina Faso 2010	3.0 [2.4, 3.9]	2.8 [2.1, 3.7]	-0.2	0.6094
Burundi 2016-17	0.8 [0.5, 1.3]	1.2 [0.9, 1.7]	0.4	0.1388
Cameroon 2011	4.0 [3.2, 5.1]	4.9 [4.0, 6.0]	0.9	0.1976
Congo 2011-12	2.7 [1.8, 4.0]	2.8 [1.9, 4.2]	0.1	0.8347
Cote d'Ivoire 2011-12	2.9 [1.9, 4.3]	2.9 [1.9, 4.2]	0.0	0.9998
DRC 2013-14	2.4 [1.8, 3.2]	2.5 [1.9, 3.3]	0.1	0.7930
Eswatini 2006-07	5.6 [4.3, 7.3]	8.5 [6.9, 10.3]	2.9	0.0244
Ethiopia 2016	1.2 [0.7, 1.9]	1.5 [1.1, 2.2]	0.3	0.3820
Gabon 2012	5.2 [3.6, 7.3]	6.7 [4.7, 9.6]	1.5	0.2787

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.16. (continued)

	Sex*			
Country and survey year	**Girls**	**Boys**	**Gap†**	**p-value‡**
		AFRICAN REGION		
Gambia 2013	1.7 [1.0, 2.8]	1.6 [0.9, 2.7]	-0.1	0.8389
Ghana 2014	1.3 [0.7, 2.2]	2.5 [1.6, 3.8]	1.2	0.0342
Guinea 2018	3.8 [2.9, 5.2]	5.5 [4.1, 7.5]	1.7	0.0869
Lesotho 2014	3.5 [2.0, 5.9]	5.4 [3.8, 7.7]	1.9	0.1651
Madagascar 2003-04	3.2 [1.5, 6.6]	3.0 [1.8, 5.0]	-0.2	0.8804
Malawi 2015-16	2.8 [2.1, 3.8]	3.9 [3.1, 5.0]	1.1	0.0898
Mali 2018	1.8 [1.2, 2.7]	1.4 [0.9, 2.1]	-0.4	0.3725
Mozambique 2011	5.4 [4.4, 6.6]	6.8 [5.6, 8.2]	1.4	0.1189
Namibia 2013	2.2 [1.3, 3.7]	2.5 [1.5, 4.4]	0.3	0.7012
Niger 2012	1.7 [1.1, 2.7]	1.6 [1.1, 2.4]	-0.1	0.8366
Nigeria 2018	1.1 [0.8, 1.5]	1.8 [1.4, 2.4]	0.7	0.0186
Rwanda 2014-15	2.7 [1.9, 3.9]	3.9 [3.0, 4.9]	1.2	0.1098

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.16. (continued)

	Sex*			
Country and survey year	**Girls**	**Boys**	**Gap†**	**p-value‡**
		AFRICAN REGION		
STP 2008-09	9.0 [6.6, 12.1]	8.1 [5.7, 11.5]	-0.9	0.6772
Senegal 2010-11	2.0 [1.2, 3.4]	1.4 [0.9, 2.1]	-0.6	0.2610
Sierra Leone 2013	7.5 [6.2, 9.2]	8.4 [6.8, 10.3]	0.9	0.4000
South Africa 2016	8.6 [5.5, 13.3]	9.5 [6.3, 14.1]	0.9	0.7458
Tanzania 2015-16	2.3 [1.8, 2.9]	3.4 [2.7, 4.1]	1.1	0.0179
Togo 2013-14	1.2 [0.7, 2.1]	2.1 [1.3, 3.2]	0.9	0.1124
Uganda 2016	1.8 [1.2, 2.6]	3.5 [2.5, 4.7]	1.7	0.0085
Zimbabwe 2015	1.9 [1.4, 2.7]	3.1 [2.3, 4.3]	1.2	0.0440
		EASTERN MEDITERRANEAN REGION		
Regional prevalence	**2.2 [0.9, 3.4]**	**2.9 [1.7, 4.0]**	**0.7**	**-**
Egypt 2014	4.2 [3.3, 5.5]	4.8 [3.8, 6.2]	0.6	0.4506
Jordan 2012	1.2 [0.6, 2.4]	1.6 [1.0, 2.5]	0.4	0.5087

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.16. (continued)

	Sex*			
Country and survey year	**Girls**	**Boys**	**Gap†**	**p-value‡**
EASTERN MEDITERRANEAN REGION				
Jordan 2012	1.2 [0.6, 2.4]	1.6 [1.0, 2.5]	0.4	0.5087
Yemen 2013	1.5 [0.9, 2.3]	2.5 [1.8, 3.5]	1.0	0.0756
EUROPEAN REGION				
Regional prevalence	**3.4 [2.1, 4.8]**	**4.2 [2.6, 5.7]**	**0.8**	**-**
Albania 2017-18	3.1 [2.1, 4.5]	5.5 [3.8, 7.8]	2.4	0.0289
Armenia 2015-16	3.2 [1.9, 5.4]	3.4 [2.1, 5.4]	0.2	0.9074
Azerbaijan 2006	4.5 [3.2, 6.2]	5.9 [4.3, 8.1]	1.4	0.1937
Kyrgyz Republic 2012	4.8 [3.7, 6.2]	5.2 [4.2, 6.5]	0.4	0.5862
Moldova 2005	3.8 [2.4, 6.0]	2.4 [1.4, 4.2]	-1.4	0.2533
Tajikistan 2017	1.4 [1.0, 2.1]	1.9 [1.4, 2.6]	0.5	0.1857

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.16. (continued)

	Sex*			
Country and survey year	**Girls**	**Boys**	**Gap†**	**p-value‡**
AMERICAS REGION				
Regional prevalence	**2.3 [1.6, 3.0]**	**2.8 [1.9, 3.7]**	**0.5**	**-**
Bolivia 2008	5.3 [3.8, 7.2]	8.1 [6.3, 10.4]	2.8	0.0354
Guatemala 2014-15	1.0 [0.7, 1.3]	1.5 [1.1, 1.9]	0.5	0.0373
Guyana 2009	3.7 [2.2, 6.2]	1.8 [0.9, 3.4]	-1.9	0.0929
Haiti 2016-17	1.7 [1.2, 2.4]	2.9 [2.3, 3.8]	1.2	0.0115
Honduras 2011-12	1.4 [1.0, 2.1]	1.3 [0.9, 1.7]	-0.1	0.5264
Peru 2012	2.5 [1.9, 3.3]	2.5 [1.9, 3.2]	0.0	0.9669
SOUTHEAST ASIAN REGION				
Regional prevalence	**1.0 [0.4, 1.6]**	**1.3 [0.9, 1.7]**	**0.3**	**-**
India 2015-16	1.2 [1.1, 1.3]	1.2 [1.1, 1.3]	0.0	0.8269

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 5.16. (continued)

	Sex*			
Country and survey year	**Girls**	**Boys**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION				
Maldives 2016-17	1.0 [0.6, 1.7]	2.5 [1.4, 4.3]	1.5	0.0164
Myanmar 2015-16	0.6 [0.3, 1.3]	1.4 [0.8, 2.4]	0.8	0.0527
Nepal 2016	0.2 [0.0, 1.3]	0.6 [0.3, 1.3]	0.4	0.2516
Timor-Leste 2016	1.9 [1.0, 3.4]	1.4 [0.8, 2.7]	-0.5	0.4839
WESTERN PACIFIC REGION				
Regional prevalence	**-**	**-**	**-**	**-**
Cambodia 2014	1.0 [0.5, 1.9]	1.7 [1.2, 2.6]	0.7	0.0893
OVERALL POOLED PREVALENCE	**2.5 [2.2, 2.8]**	**3.2 [2.8, 3.5]**	**0.7**	**-**

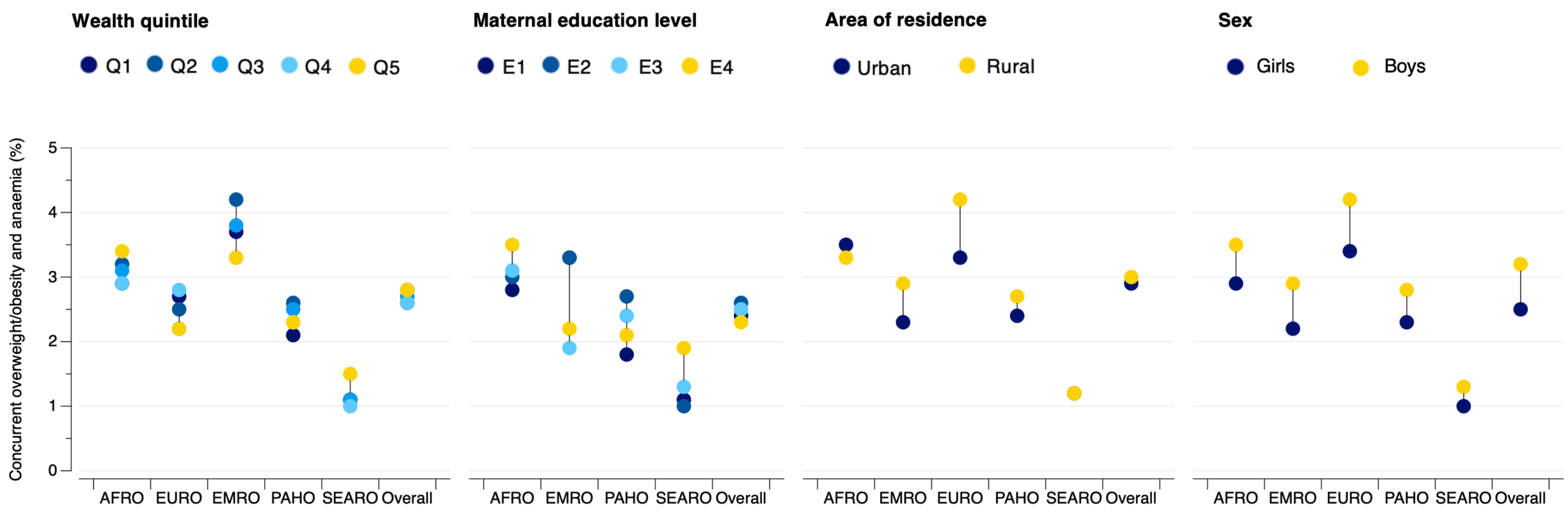
DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points, calculated as the arithmetic difference between the prevalence in urban vs. the prevalence in rural areas (%urban - %rural).
‡ p-values were obtained through chi-squared tests for each country. A p-value <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Overall, the prevalence of concurrent overweight/obesity and anaemia among children was the lowest across the three age groups studied (**Tables 5.4, 5.8** and **5.12**); however, **Figure 5.2** shows that the prevalence of DBM among children was higher than that of adolescent girls in 14 countries, and in the European region.

Patterns in the distribution of concurrent overweight/obesity and anaemia differed from those among adult women and adolescent girls (**Tables 5.13, 5.14** and **5.15**). Overall, the highest prevalence was in the second and fifth wealth quintile (2.8%), second maternal education level (2.7%), and in rural areas (3.0%) (**Figure 5.7**). Nevertheless, in the African region the distribution of the DBM by the three socioeconomic measures among children emulated that of adult women and adolescent girls, with the highest prevalence in the fifth quintile, fourth education level and urban residents. For all WHO regions, the prevalence of overweight/obesity and anaemia was slightly higher among boys than girls (3.2% vs. 2.5%) (**Table 5.16** and **Figure 5.7**).

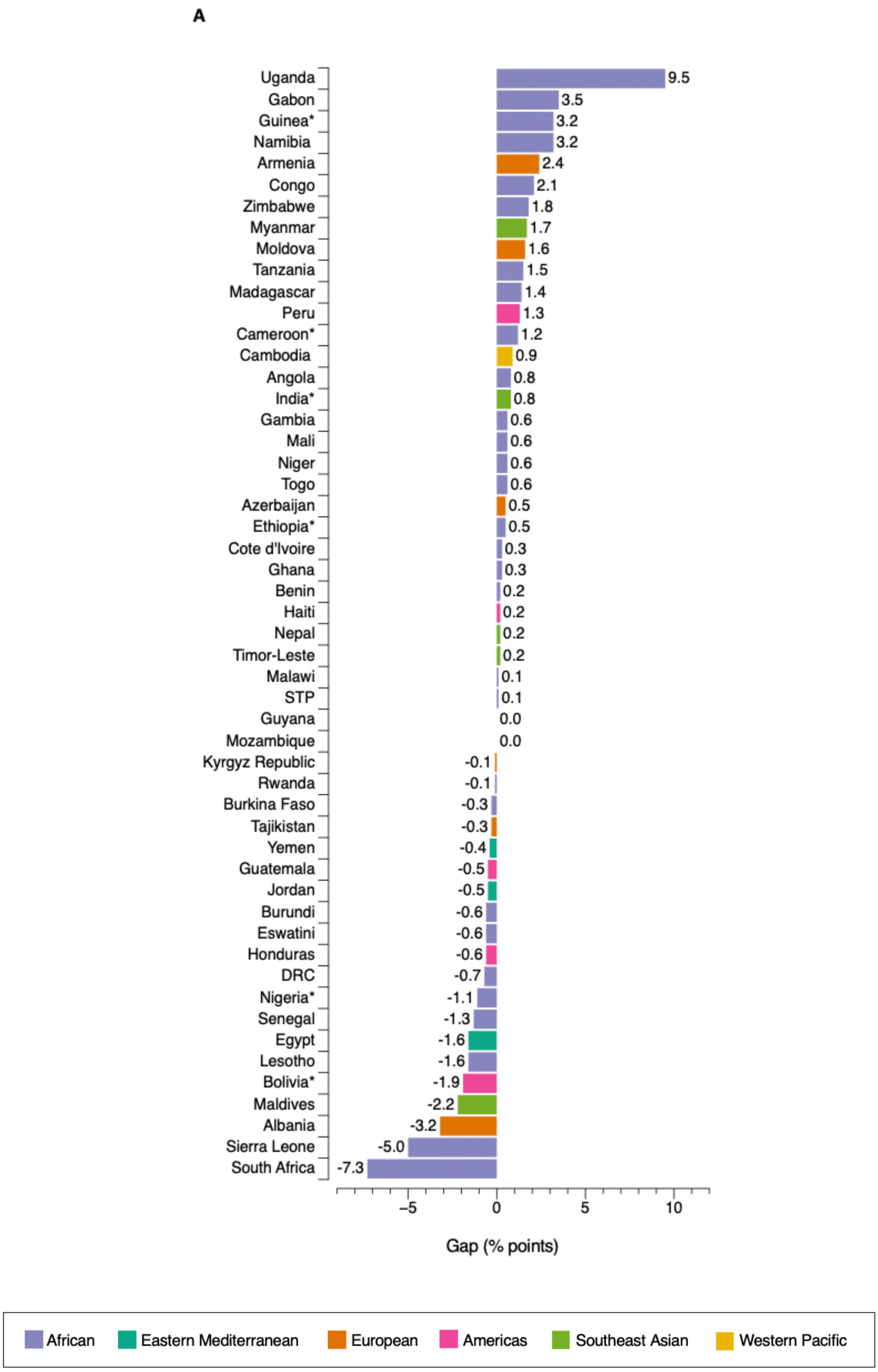
The widths of inequality gaps were smaller than those of adult women and adolescent girls overall, with only 15 instances where gaps were greater than 3.0 pp (**Figure 5.8 A, B, C** and **D**). The largest gaps were observed in Uganda, with a 9.5 (p=0.891) and a 4.5 pp difference (p=0.857) in DBM prevalence by household wealth and area of residence, respectively; and in Sierra Leone, with a 15.9 pp difference (p=0.028) by maternal education level (**Figure 5.8**). The prevalence of DBM was the same, with a gap of 0.0 pp, among the richest and poorest groups in Mozambique and Guyana; urban and rural residents in Maldives and Burundi; and boys and girls in India, Peru, Cote d'Ivoire and Benin. Differences observed among groups were significant in 11.5% (6/52), 11.1% (5/45), 11.5% (6/52), and 21.2% (11/52) of countries by household wealth, maternal education level, area of residence and sex, respectively.

Figure 5.7. Distribution of concurrent overweight/obesity and anaemia among children by wealth quintile, maternal education level, area of residence and sex across WHO regions and overall.



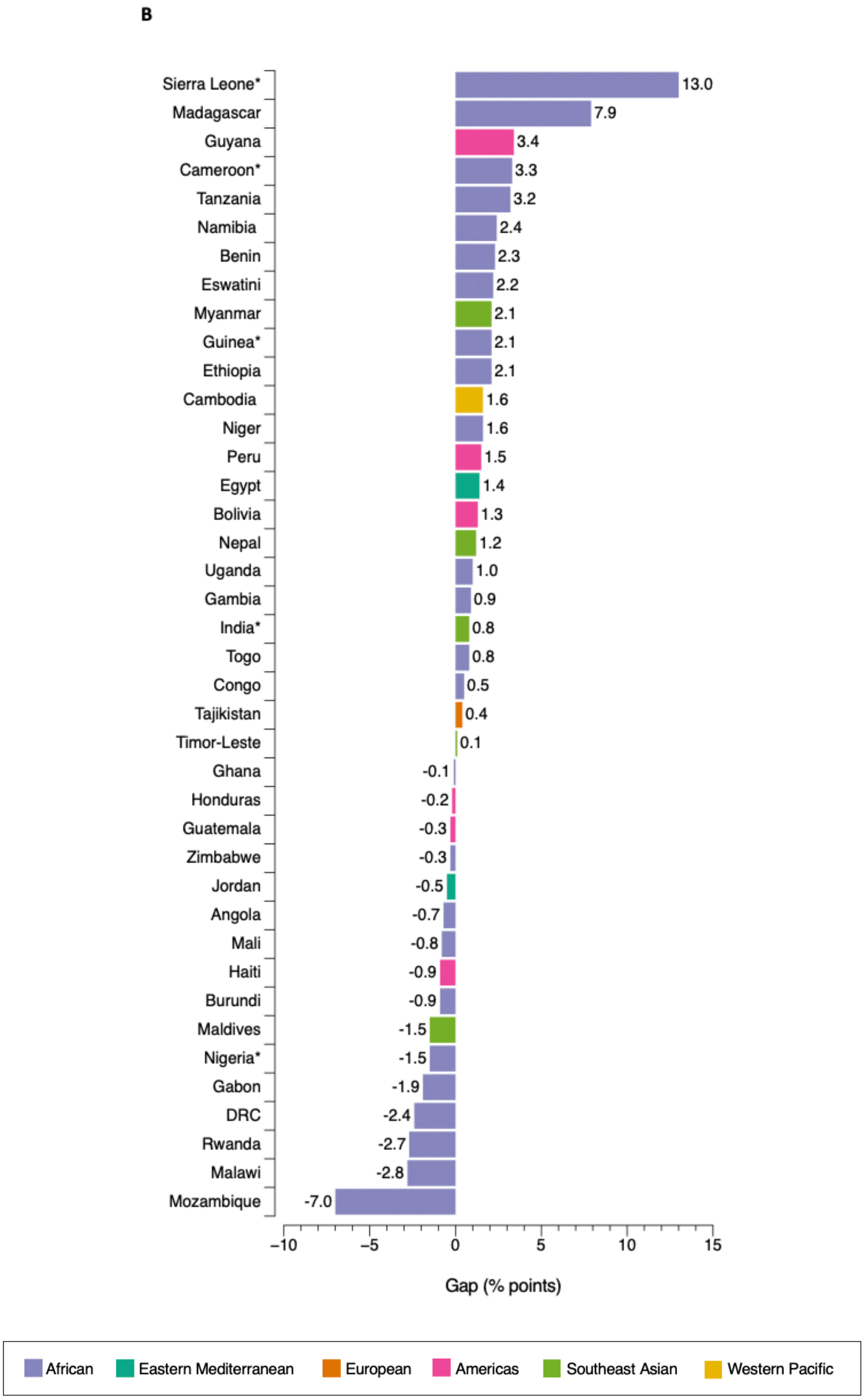
Note: Q1: poorest; Q2: poorer; Q3: middle; Q4: richer; Q5: richest; E1: no education; E2: primary education; E3: secondary education; E4: higher education; AFRO, African region; EMRO, Eastern Mediterranean region; EURO, European region, PAHO, Americas region; SEARO, Southeast Asian region. The WPRO (Western Pacific region) is missing because there was only one country with available data (Cambodia), and thus, the regional pooled prevalence could not be calculated. The pooled prevalence is also missing for the European region (by education level) due to sample sizes <25 observations.

Figure 5.8. Absolute gap difference of concurrent overweight/obesity and anaemia by wealth quintile (A), education level (B), area of residence (C) and sex (D) among children.



Note: Positive values mean that concurrent overweight/obesity and anaemia is more prevalent in the richest quintile (Q5), highest education level (E4), urban areas and among boys, when compared to the poorest quintile (Q1), lowest education level (E1), rural areas and girls. Negative values mean the opposite. (*) p-value <0.05. In figure B, Yemen was not included because data on education level was missing. Likewise, countries with a sample size <25 observations for E1 or E4 were excluded. DRC: Democratic of the Congo; STP: Sao Tome and Principe.

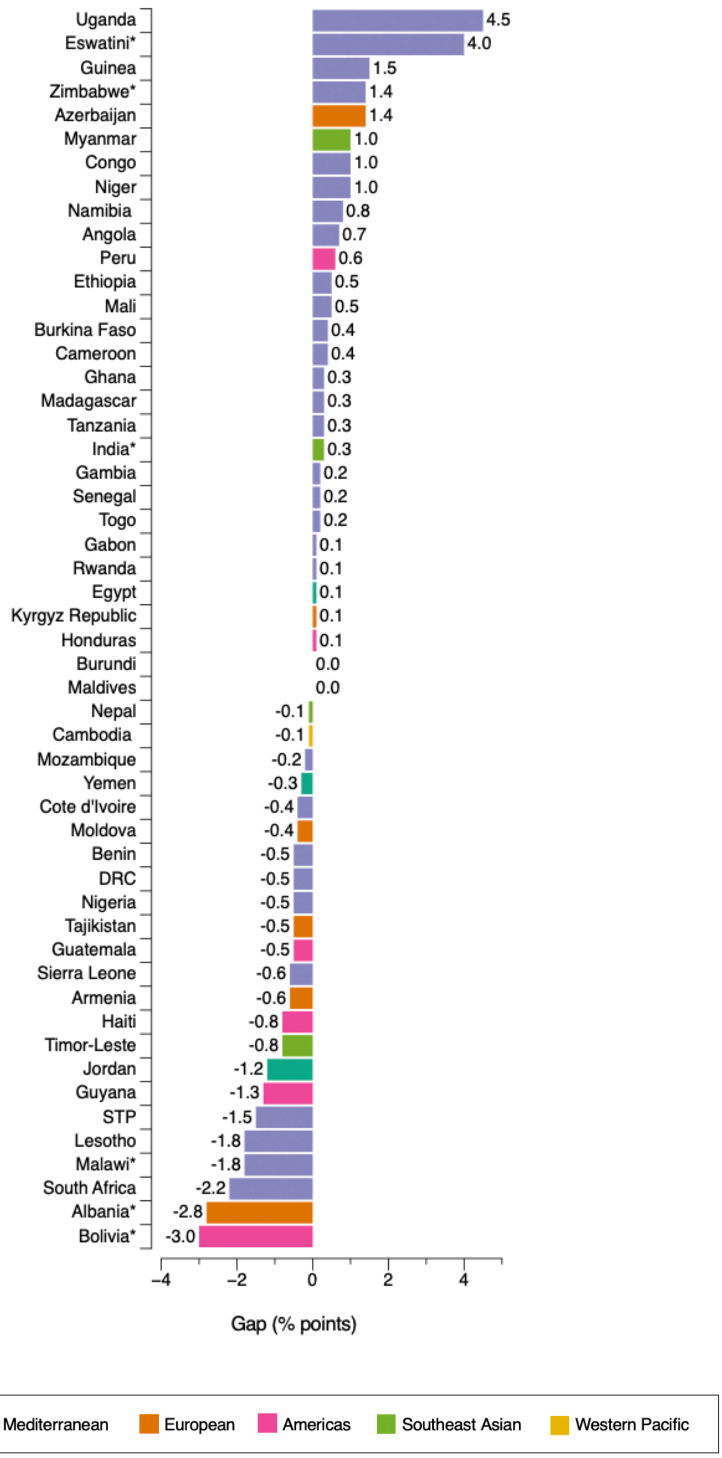
Figure 5.8. (continued)



Note: Positive values mean that concurrent overweight/obesity and anaemia is more prevalent in the richest quintile (Q5), highest education level (E4), urban areas and among boys, when compared to the poorest quintile (Q1), lowest education level (E1), rural areas and girls. Negative values mean the opposite. (*) p-value <0.05. In figure B, Yemen was not included because data on education level was missing. Likewise, countries with a sample size <25 observations for E1 or E4 were excluded. DRC: Democratic of the Congo; STP: Sao Tome and Principe.

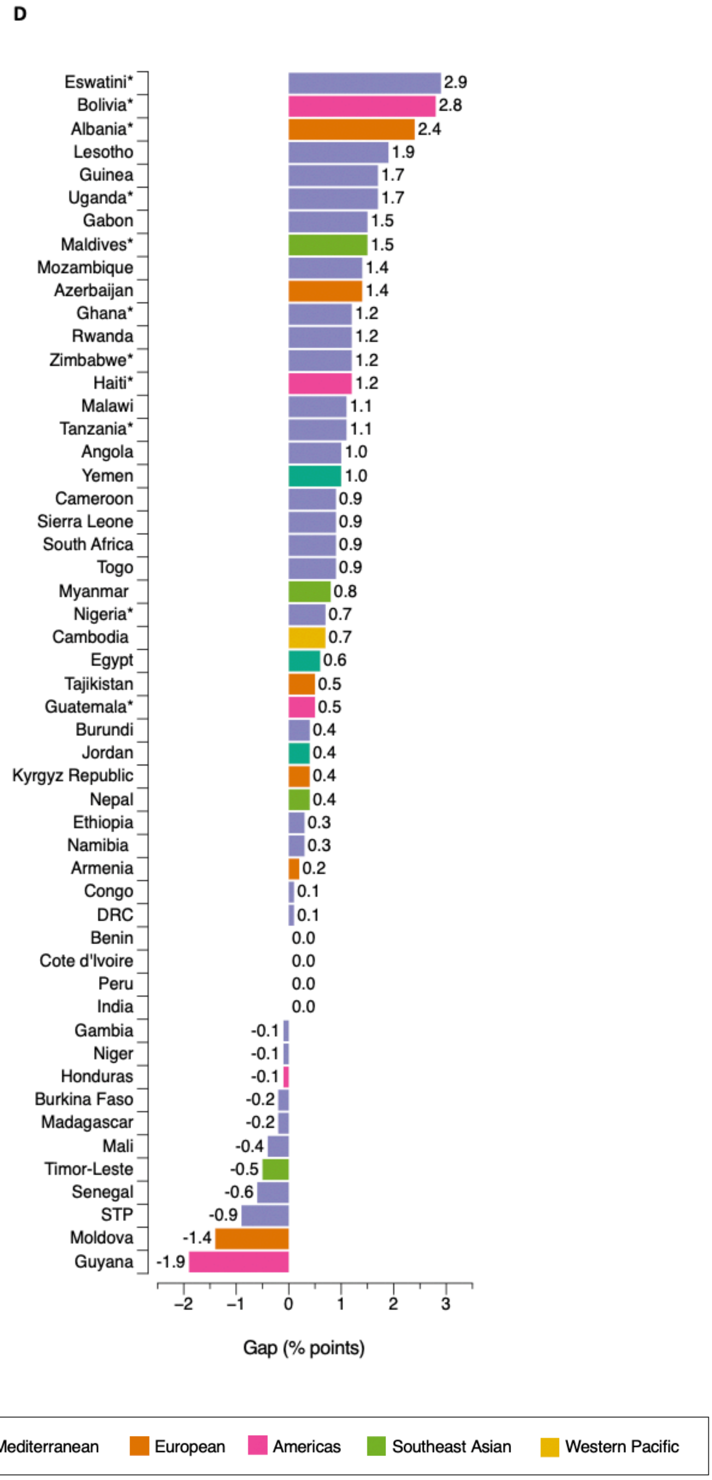
Figure 5.8. (continued)

c



Note: Positive values mean that concurrent overweight/obesity and anaemia is more prevalent in the richest quintile (Q5), highest education level (E4), urban areas and among boys, when compared to the poorest quintile (Q1), lowest education level (E1), rural areas and girls. Negative values mean the opposite. (*) p-value <0.05. In figure B, Yemen was not included because data on education level was missing. Likewise, countries with a sample size <25 observations for E1 or E4 were excluded. DRC: Democratic of the Congo; STP: Sao Tome and Principe.

Figure 5.8. (continued)



Note: Positive values mean that concurrent overweight/obesity and anaemia is more prevalent in the richest quintile (Q5), highest education level (E4), urban areas and among boys, when compared to the poorest quintile (Q1), lowest education level (E1), rural areas and girls. Negative values mean the opposite. (*) p-value <0.05. In figure B, Yemen was not included because data on education level was missing. Likewise, countries with a sample size <25 observations for E1 or E4 were excluded. DRC: Democratic of the Congo; STP: Sao Tome and Principe

5.3. Discussion

The present study provides evidence of the magnitude and distribution of overweight/obesity and anaemia at the individual level among adult women, adolescent girls, and children, using nationally representative DHS samples from 52 LMICs. The separate prevalence of both forms of malnutrition (i.e., the DBM at the population level) are also encompassed in this chapter for each age group, individual country, and WHO region.

Concurrent overweight/obesity and anaemia was common among adult women, with more than 1 in 10 simultaneously affected by the two forms of malnutrition; however, it was low among adolescent girls and children. The overall pooled prevalence estimate for adult women (12.4%) was almost three times that of the prevalence estimate for adolescent girls (4.5%), and was four times higher than that of children (3.0%). Important variations exist in the prevalence of concurrent overweight/obesity and anaemia across LMICs and WHO regions.

Williams et al. (2020) recently reported that the prevalence of overweight/obesity and anaemia at the individual level among WRA (15-49 years old) ranged between 1.0% and 18.6% (median= 8.6%); however, these data were estimated in 16 countries, including LMICs and high-income countries, using surveys from the BRINDA project (https://brinda-nutrition.org/). The prevalence estimates that are presented in this study for adult women and adolescent girls are not directly comparable with those from the above-mentioned study (Williams et al., 2020), as separate estimates were calculated for adult women (20-49 years old) and adolescent girls (15-49 years old), and only data from LMICs were included (n=51). By providing separate estimates, it is shown that the prevalence of concurrent overweight/obesity and anaemia among adolescent girls was similar to that of younger children (6-59 months), and that the prevalence of DBM among adult women was as high as 30.0% in countries such as Maldives, Jordan, or Gabon. Another study analysing anthropometric data to quantify the magnitude of DBM at the individual level (i.e., concurrent overweight/obesity and stunting) also found a low burden among adolescent girls (12-15 years old) living in LMICs, with prevalence estimates ranging from 0.0% to 7.7% (Caleyachetty et al., 2018). In this study, it was additionally observed that the difference in estimates among women and girls (7.9 pp) was primarily driven by a higher prevalence of overweight/obesity among the adult population (37.5% vs. 11.3%), with both groups bearing a similar burden of anaemia (38.7% vs. 38.8%).

The estimates presented in this chapter among children under-5 are slightly higher than those previously reported (Engle-Stone et al., 2020). The earlier study calculated the prevalence of concurrent overweight/obesity and anaemia, ranging from 0.0% to 5.0% (median= 1.4%) (Engle-Stone et al., 2020). However, in this analysis involving data from 52 LMICs, the highest prevalence of DBM among children ranged from 6.0% to 9.1% in Gabon, Mozambique, Bolivia, Eswatini, Sierra Leone, Sao Tome and Principe, and South Africa; none of which were included in the study by Engle-Stone et al. (2020). This chapter presents overlapping estimates for five countries, with a difference between 2.8 pp in Cameroon (4.5% vs. 1.7%) to 0.7 pp in Malawi (2.6% vs. 3.3%). Only in Cote d'Ivoire, our estimate is lower (2.9%) than the previously reported value (3.7%) (Engle-Stone et al., 2020), although data analysed was collected three years apart, and thus, changes in the burden of overweight/obesity and anaemia would be expected. Nevertheless, data from the same year for Cambodia (2014) and Malawi (2015-16) were used, and a higher prevalence of concurrent overweight/obesity and anaemia for both countries was obtained. Although the difference is low (< 1.5 pp), presenting different estimates can cause confusion for governments, or policy and programme planners, and hinder appropriate monitoring of the DBM. Significant differences in haemoglobin distributions across different surveys have been discussed previously and attributed to factors such as humidity, the HemoCue® model used for data collection, or the use of different survey sampling procedures (Hruschka et al., 2020). This may have had an influence in the prevalence of DBM; however, it is worth noting, that for Cambodia, the sample size included in the present analysis is significantly higher (3,799 vs. 406), which may explain the difference in estimates from a 0.0% (Engle-Stone et al., 2020) to a 1.4% in this study.

Overall, the co-occurrence of overweight/obesity and anaemia followed an inverse social gradient, emulating the distribution of overweight/obesity in LMICs (Jiwani et al., 2019; Batis et al., 2020b; Development Initiatives, 2020; Hossain et al., 2020; Jiwani et al., 2020; Matos et al., 2020). The prevalence of DBM was higher among the richest quintile and most educated groups, and urban residents had consistently a larger burden than their rural counterparts in most countries, especially among adult women and adolescent girls. This is in alignment with previous studies reporting a higher prevalence of overweight/obesity and anaemia at the individual level among the most socioeconomically advantaged, and in urban areas (Jones et al., 2016a; Williams et al., 2020). Among children, little inequalities were observed by household wealth, maternal education level, area of residence and sex; however, the prevalence of DBM was slightly higher in rural areas, with the exception of the African region, and in boys.

Larger inequality gaps were observed among adult women and adolescent girls, when compared to children, for which gaps were overall small (< 3.0 pp). Across the three age groups, the largest gaps by the three socioeconomic measures were found in African countries (e.g., Niger, Uganda, Togo and Sierra Leone) and in Yemen. There were variations in the level of inequality across countries with a similar burden of DBM. For example, among adult women, the difference between the richest and the poorest group was 7.1 pp in Maldives, where the prevalence of concurrent overweight/obesity was 33.6%; whereas, in Gabon, with a 30.1% prevalence, the inequality gap was 17.7 pp. This points to the need for context-specific solutions that appropriately address the nutritional needs of a country's population. In countries with a high prevalence of concurrent overweight/obesity and anaemia across all socioeconomic groups, population-based interventions that target both forms of malnutrition might be more suitable than targeting only the richest quintiles.

Differences observed by household wealth, education level and area of residence were significant for most countries among adult women; however, these were significant in less than 50% of countries among adolescent girls, and only a handful of countries among children. Other studies had previously identified no significant associations between sociodemographic measures (i.e., sex, area of residence, household wealth and education) and concurrent overweight/obesity and anaemia among children under-5 (Engle-Stone et al., 2020), and mixed results among WRA (Williams et al., 2020).

This study has several limitations that need to be considered. First, anaemia was used as a proxy for micronutrient deficiencies in the absence of individual micronutrient data (e.g., iron, vitamin A, etc.) in DHS surveys. The complex aetiology of anaemia in LMICs has been described in detail somewhere else (Chaparro & Suchdev, 2019). In countries with a low infection burden, the proportion of anaemic WRA and children under-5 with iron deficiency, is believed to be 71.0% and 50.0%, respectively; whereas in countries with a high infection burden, the proportion was estimated to be 58.0% among children, and as low as 35.1% among women (Engle-Stone et al., 2017; Wirth et al., 2017). Second, the independence of overweight/obesity and anaemia was not measured in this study. Excess weight has been previously linked with iron deficiency (Nemeth et al., 2004; Cepeda-Lopez et al., 2010; Zhao et al., 2015), but this association would not necessarily be true for anaemia (Ausk & Ioannou, 2008). Recent evidence found that overweight/obesity and anaemia were either two independent conditions in LMICs, or were negatively associated (i.e., odds of anaemia were higher among normal-weight than overweight/obese women) (Williams et al., 2020; Engle-Stone et al., 2020). Third, some categories created for the stratified analysis resulted in small sample sizes, and therefore, some countries could not be included into the regional prevalence, and in some cases, the regional estimate could not be calculated. Fourth, for some WHO regions, the number of countries with data on both, anthropometric measures and anaemia was low, and thus, they might be underrepresented. For example, the Western Pacific region, only had one country with available data (i.e., Cambodia), and the Eastern Mediterranean region had three countries (i.e., Egypt, Jordan and Yemen). Although most DHS surveys include weight and height measurements, not all collect data on haemoglobin levels, and thus, a number of potential countries could not be included in this study. Fifth, it is important to note that complex measures of inequalities were not used (i.e., SII) which would have allowed to take into account differences across all socioeconomic groups, including the intermediate groups; however, in this study the interest lay in measuring differences between the least and most disadvantageous groups (e.g., Q5 vs. Q1, and E4 vs. E1). Sixth, although the most recent DHS surveys available for each country were included, these were spread out over several years (from 2003 in Madagascar to 2018 in Nigeria). This might have influenced the prevalence estimates obtained and might not reflect the current magnitude of concurrent overweight/obesity and anaemia, particularly for those countries with data from older surveys.

Despite these limitations, this study included a large number of LMICs (n=52), and overall large sample sizes from nationally representative surveys were analysed. Additionally, the magnitude of concurrent overweight/obesity and anaemia is presented for adult women and adolescent girls separately, and stratified by different socioeconomic measures, which could aid in informing more precise policy responses within individual countries.

The mechanisms underpinning the simultaneous presence of overweight/obesity and anaemia across the three age groups in LMICs are likely to be multifactorial due to the varied and complex aetiology of anaemia (Engle-Stone et al., 2017; Wirth et al., 2017; Chaparro & Suchdev, 2019). Nevertheless, the fact that the highest prevalence of concurrent overweight/obesity and anaemia was found among adult women living in urban areas and those from the richest quintiles (where the risk of infectious diseases is likely to be lower) could point to unhealthy dietary practices and/or overweight/obesity as plausible factors contributing to the DBM for this age group. Nevertheless, food insecurity could also lead to a higher consumption of energy-dense nutrient-poor foods, and explain why some LMICs had a high prevalence of DBM across all wealth quintiles (Farrell et al., 2018). First, rapid changes in the food systems of LMICs are resulting in an increased availability of ultra-processed foods, which are easily accessible and affordable (Popkin et al., 2012; Monteiro et al., 2013; Development Initiatives, 2020; Popkin et al., 2020). A high consumption of these foods rich in fats and poor in vitamins and minerals could make women more prone to develop both, weight gain and anaemia, as a result of iron-deficiency (or other micronutrient deficiencies) from the diet. Second, overweight/obesity can also lead to iron-deficiency due to increases in hepcidin, which reduces the absorption of iron from the diet (Nemeth, et al., 2004). Data on dietary practices, as well as on the causes of anaemia, are needed in nationally representative surveys (e.g., DHS), in order to better elucidate the causes of concurrent overweight/obesity and anaemia.

Double-duty actions, proposed to address forms of undernutrition and overweight/obesity (Hawkes et al., 2020), might have a positive effect in preventing and reducing the dual burden of overweight/obesity and anaemia (e.g., changes in the food environment conducive to supporting healthy diets, scale up of programmes that protect breastfeeding and offer a better guidance for complementary feeding practices, counselling about healthy eating during antenatal care, etc). Yet, the effectiveness of double-duty actions still needs to be tested in this context. For women who are already living with overweight/obesity, weight reduction could translate into better absorption of micronutrients (e.g., iron) from the diet, and hence, increased haemoglobin levels.

Furthermore, further research is needed to elucidate the full implications of concurrent overweight/obesity and anaemia, particularly among WRA, for whom the burden was highest. Women who enter pregnancy with concurrent overweight/obesity and anaemia, might be confronted with adverse maternal, obstetric and birth outcomes related to both, anaemia, and adiposity. Management of both of these conditions would be particularly challenging for many health systems in LMICs which are underdeveloped (Mills, 2014), and might need to be redesigned to contend with women presenting with the dual burden of overweight/obesity and anaemia. Likewise, adolescent girls, who showed an overall low prevalence of DBM, could be a crucial second window of opportunity to act early on and prevent the detrimental intergenerational consequences of malnutrition, as well as to improve pregnancy outcomes (Wells et al., 2020).

In conclusion, this study demonstrated a high prevalence of concurrent overweight/obesity and anaemia among adult women, and a much lower prevalence among adolescent girls and children under-5. Concurrent overweight/obesity and anaemia was unequally distributed across wealth quintiles, education levels and area of residence. As the prevalence of overweight/obesity continues to increase rapidly across LMICs in response to the nutrition transition (Development Initiatives, 2020; Popkin et al., 2020), this may translate in increases in concurrent overweight/obesity and anaemia. Similarly, changes in the distribution of this form of DBM might also occur, in view of the obesity shift towards rural residents and the poor (Mills, 2014; Jiwani et al., 2019; NCD-RisC, 2019; Templin et al., 2019). Given the variation in the magnitude and distribution observed, context-specific, multifaceted, and equity-focused programmatic and policy responses that address all forms of malnutrition are needed.

5.4. Chapter summary

In this chapter, the results of the study on the magnitude, distribution, and inequalities of the intra-individual DBM were presented and discussed.

KEY FINDINGS

- The pooled prevalence of concurrent overweight/obesity and anaemia was 12.4% (95% CI: 11.1, 13.7) among adult women (20-49 years old), 4.5% (95% CI: 4.0, 5.0) among adolescent girls (15-19 years old), and 3.0% (95% CI: 2.7, 3.3) among children (6-59 months) living in the 52 LMICs included in the analysis.
- Prevalence estimates in the intra-individual DBM varied across WHO regions, LMICs, and socioeconomic subgroups.
- At the population level, the prevalence of overweight/obesity was 37.5% (95% CI: 32.0, 43.0) among adult women, 11.3% (95% CI: 9.9, 12.7) among adolescent girls, and 6.3% (95% CI: 5.7, 7.0) among children; whereas the prevalence of anaemia was 38.7% (95% CI: 34.2, 43.3) among adult women, 38.8% (95% CI: 33.7, 43.9) among adolescent girls, and 55.9% (95% CI: 51.7, 60.1) among children.

In the next chapter, the findings on the magnitude, distribution, and inequalities of the double burden of overweight/obesity and anaemia at the household level are presented and discussed.

CHAPTER 6

The intra-household double burden of overweight/ obesity and anaemia: magnitude, distribution, and inequalities

6.1. Chapter overview

This chapter provides the results and discussion of the magnitude, distribution, and inequalities of the intra-household DBM. The characteristics of surveys and households included in the analysis are presented first. The findings are then displayed by form of household-level DBM studied (i.e., 1) total intra-household DBM; 2) mothers with overweight/obesity and children with anaemia; and 3) mothers with anaemia and children with overweight/obesity). The results section is followed by a discussion section, where the key findings are summarised and compared with the existing literature. The weaknesses and strengths of this study are also discussed.

6.2. Results

6.2.1. Characteristics of surveys and households

Overall, 49 LMICs had a DHS between 2005 and 2018 with available anthropometric and anaemia measures for both, mothers and their children under-5. By WHO region, per total number of LMICs included in the study (n=49), 59.2% (n=29) were from the African region, 4.1% (n=2) from the Eastern Mediterranean region, 12.2% (n=6) from the European region, 12.2% (n=6) from the Americas region, 10.2% (n=5) from the Southeast Asian region and 2.1% (n=1) from the Western Pacific region. The total analytical sample size comprised 311,604 households (encompassing mothers and their children under-5) with 272,039 households for mothers with overweight/obesity and children with anaemia, and 286,414 households for mothers with anaemia and children with overweight/obesity. The total household-level DBM was calculated in a total sample of 292,977 households. Characteristics of households included in the study are provided for each country in **Tables 6.1** and **6.2**.

Table 6.1. Sociodemographic characteristics of households included in the study.

Country and survey year	**Sample size,** ***n***	**Urban** (%)	**Q1** (%)	**Q5** (%)	**E1** (%)	**E4** (%)
AFRICAN REGION						
Benin 2017-18	3,507	39.3 [36.5, 42.2]	18.3 [16.0, 20.9]	19.6 [17.5, 21.9]	65.0 [62.8, 67.2]	1.4 [1.0, 2.0]
Burkina Faso 2010	4,049	19.7 [18.2, 21.3]	20.1 [18.4, 22.0]	17.6 [16.0, 19.4]	81.5 [79.9, 82.9]	0.4 [0.3, 0.7]
Burundi 2016-17	3,399	9.4 [7.7, 11.4]	22.8 [21.1, 24.5]	16.0 [14.1, 18.2]	46.0 [43.8, 48.2]	0.8 [0.5, 1.3]
Cameroon 2011	2,919	46.2 [43.3, 49.1]	20.2 [18.0, 22.6]	18.7 [16.7, 20.8]	24.8 [22.1, 27.6]	3.5 [2.8, 4.5]
Congo 2011-12	2,704	63.0 [59.6, 66.3]	20.7 [18.4, 23.1]	17.1 [14.2, 20.5]	5.9 [4.7, 7.3]	4.0 [2.9, 5.6]
Cote d'Ivoire 2011-12	1,971	38.6 [34.7, 42.6]	23.7 [19.9, 28.1]	15.4 [12.8, 18.4]	63.4 [59.6, 67.0]	0.6 [0.3, 1.3]
DRC 2013-14	4,096	30.4 [26.8, 34.2]	22.3 [19.9, 24.9]	16.4 [14.0, 19.2]	19.5 [17.3, 21.9]	1.5 [1.1, 2.2]
Eswatini 2006-07	1,495	19.1 [16.5, 22.0]	20.7 [18.1, 23.7]	17.6 [15.0, 20.6]	8.3 [6.7, 10.1]	6.5 [5.2, 8.2]
Ethiopia 2016	5,281	13.3 [11.7, 15.1]	20.9 [17.8, 24.4]	17.2 [15.2, 19.4]	63.5 [60.8, 66.1]	2.9 [2.1, 3.9]
Gabon 2012	2,036	85.9 [83.6, 88.0]	18.8 [16.4, 21.6]	18.5 [14.5, 23.3]	6.6 [4.7, 9.1]	7.7 [5.6, 10.5]
Gambia 2013	1,868	48.3 [43.9, 52.7]	19.9 [17.3, 22.8]	18.8 [15.6, 22.5]	58.4 [54.7, 61.9]	3.3 [1.9, 5.6]
Ghana 2014	1,727	47.6 [43.9, 51.3]	21.7 [18.9, 24.8]	18.3 [15.4, 21.6]	27.0 [23.8, 30.6]	3.3 [2.4, 4.7]
Guinea 2018	2,103	29.6 [27.1, 32.2]	23.0 [20.4, 25.8]	16.3 [14.3, 18.6]	75.5 [73.1, 77.8]	2.2 [1.6, 3.0]
Lesotho 2014	1,039	25.8 [21.6, 30.6]	20.1 [17.1, 23.5]	16.9 [13.5, 20.9]	0.9 [0.5, 1.6]	6.7 [5.1, 8.8]
Malawi 2015-16	3,672	14.4 [13.3, 15.6]	23.3 [21.7, 25.0]	17.4 [15.8, 19.0]	12.8 [11.5, 14.3]	2.2 [1.3, 3.4]

Values are prevalence estimates and 95% CI, unless otherwise indicated. Q1, poorest household wealth quintile; Q5, richest household wealth quintile; E1, lowest maternal education; E4, highest maternal education; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 6.1. (continued)

Country and survey year	**Sample size,** *n*	**Urban** (%)	**Q1** (%)	**Q5** (%)	**E1** (%)	**E4** (%)
AFRICAN REGION						
Mali 2018	2,374	22.0 [19.2, 25.2]	19.4 [16.7, 22.4]	18.5 [15.8, 21.5]	71.7 [68.9, 74.4]	1.6 [1.1, 2.3]
Mozambique 2011	5,671	29.5 [27.5, 31.6]	21.5 [19.5, 23.7]	18.0 [16.2, 19.9]	35.8 [33.5, 38.1]	0.7 [0.5, 1.0]
Namibia 2013	1,313	44.5 [41.6, 47.4]	22.4 [19.5, 25.6]	12.3 [9.8, 15.2]	6.3 [5.1, 7.9]	5.3 [3.8, 7.2]
Niger 2012	2,553	15.8 [14.2, 17.5]	18.5 [16.4, 20.8]	19.7 [17.4, 22.3]	85.0 [83.3, 86.5]	0.4 [0.3, 0.7]
Nigeria 2018	6,244	44.8 [42.8, 46.8]	18.1 [16.6, 19.8]	20.8 [19.0, 22.7]	36.8 [34.9, 38.8]	10.1 [8.9, 11.4]
Rwanda 2014-15	2,400	16.1 [14.7, 17.5]	24.4 [22.5, 26.4]	16.6 [15.1, 18.2]	14.6 [13.0, 16.2]	1.9 [1.4, 2.6]
STP 2008-09	1,118	49.3 [44.3, 54.2]	21.1 [18.0, 24.5]	17.7 [13.7, 22.5]	4.9 [3.6, 6.7]	0.7 [0.2, 1.8]
Senegal 2010-11	2,208	42.1 [38.2, 46.0]	20.4 [17.7, 23.3]	17.8 [14.5, 21.7]	69.3 [65.8, 72.5]	1.0 [0.5, 2.2]
Sierra Leone 2013	3,098	26.1 [23.4, 28.9]	21.6 [18.8, 24.7]	15.4 [13.3, 17.7]	68.0 [65.6, 70.3]	1.3 [0.9, 1.9]
South Africa 2016	868	56.8 [52.6, 60.8]	23.8 [19.5, 28.8]	10.3 [7.2, 14.5]	2.1 [1.2, 3.8]	9.9 [6.8, 14.0]
Tanzania 2015-16	5,350	29.4 [27.2, 31.7]	20.8 [18.4, 23.3]	19.2 [17.3, 21.2]	19.3 [17.5, 21.2]	0.8 [0.6, 1.2]
Togo 2013-14	2,043	36.8 [34.0, 39.5]	21.5 [19.1, 24.1]	19.3 [16.9, 21.8]	38.7 [35.1, 42.4]	1.6 [1.0, 2.7]
Uganda 2016	2,500	22.8 [20.8, 24.9]	20.1 [18.2, 22.2]	22.0 [19.4, 24.9]	11.2 [9.8, 12.7]	6.9 [5.6, 8.6]
Zimbabwe 2015	3,612	30.3 [27.6, 33.1]	23.5 [20.8, 26.4]	16.8 [14.7, 19.0]	1.3 [0.8, 2.1]	5.1 [4.1, 6.4]

Values are prevalence estimates and 95% CI, unless otherwise indicated. Q1, poorest household wealth quintile; Q5, richest household wealth quintile; E1, lowest maternal education; E4, highest maternal education; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 6.1. (continued)

Country and survey year	**Sample size,** ***n***	**Urban** (%)	**Q1** (%)	**Q5** (%)	**E1** (%)	**E4** (%)
EASTERN MEDITERRANEAN REGION						
Egypt 2014	9,090	32.4 [30.7, 34.2]	17.0 [15.5, 18.5]	17.6 [16.3, 19.1]	17.9 [16.6, 19.1]	16.0 [14.9, 17.2]
Yemen 2013	7,524	30.4 [28.2, 32.7]	19.8 [17.4, 22.4]	20.6 [18.5, 22.8]	-	-
EUROPEAN REGION						
Albania 2017-18	1,940	55.0 [51.5, 58.3]	23.2 [20.6, 26.0]	17.1 [14.3, 20.3]	1.1 [0.5, 2.3]	25.6 [22.7, 28.8]
Armenia 2015-16	1,172	57.2 [54.0, 60.4]	19.2 [16.6, 22.1]	22.8 [18.5, 27.7]	0.0 [0.0, 0.0]	54.6 [51.3, 57.8]
Azerbaijan 2006	1,343	51.6 [47.2, 56.0]	22.0 [18.6, 25.8]	17.1 [14.0, 20.6]	1.2 [0.5, 2.6]	14.8 [12.3, 17.7]
Kyrgyz Republic 2012	2,531	30.2 [27.2, 33.4]	18.7 [16.0, 21.6]	17.2 [14.2, 20.7]	0.0 [0.0, 0.1]	44.4 [41.3, 47.5]
Moldova 2005	1,146	39.2 [36.5, 42.0]	18.1 [15.4, 21.0]	21.1 [18.4, 24.1]	0.4 [0.1, 1.1]	18.9 [16.6, 21.5]
Tajikistan 2017	3,426	22.7 [21.0, 24.6]	18.7 [16.0, 21.8]	18.2 [16.3, 20.3]	2.5 [1.9, 3.5]	16.0 [14.3, 18.0]
AMERICAS REGION						
Bolivia 2008	5,217	58.0 [55.8, 60.2]	22.1 [20.0, 24.4]	15.5 [13.9, 17.3]	5.5 [4.6, 6.5]	13.3 [12.0, 14.7]
Guatemala 2014-15	8,003	38.6 [36.7, 40.6]	22.8 [20.9, 24.7]	15.7 [14.4, 17.1]	16.8 [15.6, 18.2]	4.3 [3.7, 4.8]
Guyana 2009	1,130	24.7 [21.4, 28.2]	25.3 [21.1, 30.0]	18.3 [15.2, 21.9]	3.0 [1.6, 5.4]	7.1 [5.4, 9.4]
Haiti 2016-17	2,551	36.6 [33.7, 39.6]	21.9 [19.2, 24.9]	17.1 [14.6, 20.0]	18.2 [16.0, 20.7]	3.8 [2.9, 4.9]

Values are prevalence estimates and 95% CI, unless otherwise indicated. Q1, poorest household wealth quintile; Q5, richest household wealth quintile; E1, lowest maternal education; E4, highest maternal education; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 6.1. (continued)

Country and survey year	**Sample size,** ***n***	**Urban** (%)	**Q1** (%)	**Q5** (%)	**E1** (%)	**E4** (%)
AMERICAS REGION						
Honduras 2011-12	7,272	46.9 [45.1, 48.7]	22.6 [21.1, 24.2]	15.6 [14.1, 17.2]	4.5 [4.0, 5.1]	5.2 [4.5, 6.0]
Peru 2012	7,043	67.1 [65.4, 68.8]	21.4 [19.9, 23.0]	13.8 [12.2, 15.6]	2.8 [2.4, 3.4]	24.0 [22.4, 25.7]
SOUTHEAST ASIAN REGION						
India 2015-16	155,276	30.0 [29.5, 30.5]	22.8 [22.5, 23.2]	17.0 [16.6, 17.4]	27.2 [26.8, 27.6]	12.1 [11.8, 12.5]
Maldives 2016-17	1,937	30.6 [27.6, 33.8]	21.9 [19.6, 24.4]	13.9 [10.9, 17.4]	1.3 [0.9, 2.0]	20.2 [16.9, 24.0]
Myanmar 2015-16	3,161	23.1 [20.9, 25.4]	26.9 [24.3, 29.7]	15.3 [13.3, 17.6]	15.0 [12.9, 17.5]	8.6 [7.2, 10.2]
Nepal 2016	1,708	54.2 [48.9, 59.4]	20.1 [17.1, 23.4]	14.4 [11.6, 17.7]	32.8 [29.7, 36.1]	14.9 [12.8, 17.3]
Timor-Leste 2016	3,624	28.4 [25.6, 31.3]	19.8 [17.5, 22.3]	20.0 [17.6, 22.4]	24.6 [22.8, 26.6]	8.9 [7.6, 10.4]
WESTERN PACIFIC REGION						
Cambodia 2014	3,292	14.3 [12.8, 16.0]	23.5 [20.8, 26.4]	19.0 [17.0, 21.3]	12.8 [11.2, 14.6]	2.5 [1.9, 3.2]

Values are prevalence estimates and 95% CI, unless otherwise indicated. Q1, poorest household wealth quintile; Q5, richest household wealth quintile; E1, lowest maternal education; E4, highest maternal education; DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.

Table 6.2. Bivariate prevalence of overweight/obesity and anaemia of households included in the study.

Country and survey year	**Sample size, *n***	**Maternal anaemia**	**Childhood anaemia***	**Maternal OWOB**	**Childhood OWOB***
AFRICAN REGION					
Benin 2017-18	3,507	55.9 [53.9, 57.8]	78.5 [76.9, 80.1]	25.3 [23.5, 27.3]	2.3 [1.8, 3.0]
Burkina Faso 2010	4,049	48.2 [46.3, 50.1]	90.6 [89.4, 91.7]	9.5 [8.5, 10.7]	4.9 [4.1, 5.9]
Burundi 2016-17	3,399	42.9 [40.8, 45.0]	68.9 [66.9, 70.7]	7.5 [6.4, 8.7]	2.3 [1.8, 2.9]
Cameroon 2011	2,919	36.1 [34.0, 38.2]	69.3 [67.3, 71.3]	30.9 [28.9, 33.0]	10.8 [9.5, 12.3]
Congo 2011-12	2,704	53.9 [51.0, 56.8]	72.9 [70.1, 75.6]	24.7 [22.1, 27.5]	5.3 [4.0, 6.9]
Cote d'Ivoire 2011-12	1,971	54.1 [51.0, 57.2]	79.5 [77.1, 81.6]	22.9 [20.6, 25.3]	5.5 [4.3, 7.1]
DRC 2013-14	4,096	37.4 [34.6, 40.2]	68.7 [66.1, 71.2]	15.0 [17.3, 17.3]	8.3 [7.1, 9.6]
Eswatini 2006-07	1,495	26.9 [23.9, 30.1]	48.4 [45.2, 51.6]	54.6 [51.7, 57.4]	16.6 [14.7, 18.8]
Ethiopia 2016	5,281	27.0 [24.7, 29.4]	62.1 [59.5, 64.5]	6.4 [5.5, 7.4]	4.3 [3.4, 5.3]
Gabon 2012	2,036	60.7 [57.4, 63.8]	66.2 [62.6, 69.6]	44.4 [41.2, 47.6]	11.7 [9.2, 14.8]
Gambia 2013	1,868	61.4 [58.0, 64.6]	80.1 [76.9, 83.1]	22.2 [19.4, 25.2]	5.1 [3.8, 6.8]
Ghana 2014	1,727	41.2 [38.2, 44.3]	69.6 [66.6, 72.4]	40.5 [37.6, 43.5]	4.0 [3.0, 5.3]
Guinea 2018	2,103	44.3 [41.7, 46.9]	80.8 [78.6, 82.8]	26.9 [24.5, 29.5]	8.1 [6.6, 9.8]
Lesotho 2014	1,039	24.6 [21.2, 28.3]	56.6 [52.2, 60.8]	45.0 [41.2, 48.9]	9.7 [7.9, 12.0]
Malawi 2015-16	3,672	27.7 [25.8, 29.6]	66.6 [64.5, 68.6]	19.3 [17.7, 21.0]	6.3 [5.3, 7.4]

Values are prevalence estimates and 95% CI, unless otherwise indicated. DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity.
*Prevalence of households with at least one child living with anaemia or overweight/obesity, respectively.

Table 6.2. (continued)

Country and survey year	Sample size, *n*	Maternal anaemia	Childhood anaemia*	Maternal OWOB	Childhood OWOB*
AFRICAN REGION					
Mali 2018	2,374	62.1 [59.4, 64.7]	88.1 [86.4, 89.6]	27.1 [24.7, 29.7]	3.0 [2.3, 3.9]
Mozambique 2011	5,671	52.9 [50.7, 55.0]	74.9 [72.8, 76.9]	13.3 [12.2, 14.5]	14.1 [12.8, 15.5]
Namibia 2013	1,313	18.5 [16.0, 21.3]	54.6 [50.9, 58.2]	31.3 [28.4, 34.4]	5.5 [4.2, 7.1]
Niger 2012	2,553	40.1 [37.4, 42.8]	83.6 [81.6, 85.3]	18.2 [16.5, 20.2]	4.5 [3.5, 5.8]
Nigeria 2018	6,244	57.2 [55.6, 58.8]	74.0 [72.4, 75.5]	29.7 [28.1, 31.3]	3.4 [2.9, 4.0]
Rwanda 2014-15	2,400	17.4 [15.7, 19.2]	42.9 [40.7, 45.1]	21.7 [20.0, 23.5]	13.6 [12.2, 15.0]
STP 2008-09	1,118	40.5 [35.8, 45.4]	70.2 [67.1, 73.2]	35.9 [31.8, 40.2]	17.7 [14.9, 20.9]
Senegal 2010-11	2,208	50.8 [47.7, 54.0]	83.2 [80.4, 85.7]	21.6 [19.1, 24.4]	4.8 [3.7, 6.2]
Sierra Leone 2013	3,098	44.3 [41.9, 46.7]	84.1 [82.4, 85.7]	16.0 [14.3, 17.9]	14.1 [12.3, 16.1]
South Africa 2016	868	27.3 [22.3, 32.9]	65.4 [60.5, 70.0]	64.8 [60.3, 69.1]	17.4 [14.3, 21.0]
Tanzania 2015-16	5,350	42.1 [40.2, 44.2]	64.4 [62.7, 66.0]	25.8 [24.2, 27.3]	6.3 [5.5, 7.1]
Togo 2013-14	2,043	43.6 [41.3, 45.9]	76.2 [73.9, 78.3]	27.9 [25.6, 30.3]	3.1 [2.3, 4.1]
Uganda 2016	2,500	29.2 [26.9, 31.6]	59.9 [57.4, 62.4]	23.8 [21.7, 26.1]	6.5 [5.5, 7.7]
Zimbabwe 2015	3,612	22.2 [20.6, 23.9]	42.6 [40.3, 44.9]	35.2 [33.2, 37.4]	7.5 [6.5, 8.5]

Values are prevalence estimates and 95% CI, unless otherwise indicated. DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity.
*Prevalence of households with at least one child living with anaemia or overweight/obesity, respectively.

Table 6.2. (continued)

Country and survey year	Sample size, *n*	Maternal anaemia	Childhood anaemia*	Maternal OWOB	Childhood OWOB*
EASTERN MEDITERRANEAN REGION					
Egypt 2014	9,090	26.0 [24.0, 28.1]	32.5 [30.4, 34.8]	80.1 [78.9, 81.2]	21.5 [20.2, 22.9]
Yemen 2013	7,524	71.5 [68.7, 74.2]	89.9 [88.1, 91.4]	26.6 [25.1, 28.2]	4.5 [3.9, 5.2]
EUROPEAN REGION					
Albania 2017-18	1,940	23.6 [20.9, 26.6]	26.3 [23.4, 29.4]	42.3 [39.2, 45.5]	20.1 [17.7, 22.7]
Armenia 2015-16	1,172	11.6 [9.8, 13.8]	17.4 [15.0, 20.1]	37.0 [33.8, 40.3]	17.6 [15.1, 20.5]
Azerbaijan 2006	1,343	40.0 [36.9, 4.3]	43.7 [40.1, 47.5]	43.8 [40.1, 47.6]	19.7 [17.2, 22.4]
Kyrgyz Republic 2012	2,531	38.6 [35.8, 41.4]	48.2 [45.4, 51.1]	33.8 [31.7, 35.8]	13.5 [11.8, 15.3]
Moldova 2005	1,146	30.5 [27.3, 33.9]	34.2 [31.4, 37.2]	34.6 [31.6, 37.7]	11.4 [9.5, 13.7]
Tajikistan 2017	3,426	45.4 [43.1, 47.7]	49.5 [46.8, 52.3]	32.4 [30.5, 34.3]	5.4 [4.5, 6.4]
AMERICAS REGION					
Bolivia 2008	5,217	40.2 [37.4, 43.1]	65.9 [62.9, 68.8]	51.7 [49.9, 53.6]	13.5 [12.3, 14.8]
Guatemala 2014-15	8,003	13.2 [12.3, 14.3]	37.4 [35.8, 39.0]	52.2 [50.8, 53.7]	6.2 [5.6, 6.8]
Guyana 2009	1,130	36.4 [33.1, 39.8]	41.5 [37.2, 45.9]	48.9 [45.1, 52.9]	11.3 [9.0, 14.0]
Haiti 2016-17	2,551	45.7 [43.2, 48.3]	69.8 [67.2, 72.2]	35.2 [32.7, 37.7]	4.4 [3.5, 5.4]

Values are prevalence estimates and 95% CI, unless otherwise indicated. DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity.
*Prevalence of households with at least one child living with anaemia or overweight/obesity, respectively.

Table 6.2. (continued)

Country and survey year	Sample size, *n*	Maternal anaemia	Childhood anaemia*	Maternal OWOB	Childhood OWOB*
AMERICAS REGION					
Honduras 2011-12	7,272	13.6 [12.6, 14.6]	32.7 [31.2, 34.3]	51.8 [50.2, 53.3]	7.1 [6.4, 7.9]
Peru 2012	7,043	17.7 [16.5, 19.0]	34.9 [33.3, 36.6]	59.5 [57.9, 61.1]	9.8 [8.8, 10.9]
SOUTHEAST ASIAN REGION					
India 2015-16	155,276	56.1 [55.7, 56.5]	62.5 [62.1, 62.9]	16.3 [16.0, 16.6]	3.6 [3.4, 3.7]
Maldives 2016-17	1,937	61.6 [58.6, 64.4]	53.3 [50.4, 56.2]	53.7 [50.5, 56.9]	5.9 [4.8, 7.3]
Myanmar 2015-16	3,161	42.2 [40.1, 44.4]	62.6 [60.2, 64.9]	26.9 [24.9, 29.1]	1.7 [1.2, 2.3]
Nepal 2016	1,708	43.6 [40.6, 46.7]	56.3 [53.2, 59.3]	17.5 [15.3, 20.0]	1.4 [0.9, 2.0]
Timor-Leste 2016	3,624	23.1 [20.7, 25.7]	48.6 [45.1, 52.2]	12.8 [11.4, 14.3]	8.4 [7.4, 9.6]
WESTERN PACIFIC REGION					
Cambodia 2014	3,292	43.7 [41.5, 45.8]	60.8 [58.5, 63.1]	17.6 [16.0, 19.3]	3.0 [2.4, 3.9]

Values are prevalence estimates and 95% CI, unless otherwise indicated. DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity.
*Prevalence of households with at least one child living with anaemia or overweight/obesity, respectively.

The proportion of households in the poorest group (Q1) ranged from 17.0% (Egypt) to 25.3% (Guyana), and from 12.3% (Namibia) to 22.8% (Armenia) for households in the richest group (Q5) (**Table 6.1**). Niger had the highest prevalence of households with mothers with no education (85.0%); whereas Armenia had the lowest prevalence of uneducated mothers (0.0%) and the highest prevalence of higher maternal education (54.6%) (**Table 6.1**). The proportion of urban households ranged from 9.4% in Burundi to 85.9% in Gabon (**Table 6.1**). Individual forms of malnutrition were higher in Egypt for households with mothers with overweight/obesity (80.1%) and households where at least one child was affected by overweight/obesity (21.5%); in Yemen (71.5%) for households with mothers with anaemia; and in Burkina Faso (90.6%) for households where at least one child had anaemia (**Table 6.2**).

6.2.2. Total double burden of malnutrition at the household level

The pooled prevalence of total intra-household DBM was 17.2% (95% CI: 15.6, 18.8; I^2: 99.2%), ranging from 4.1% in Ethiopia to 38.7% in South Africa (**Figure 6.1** and **Table 6.3**). The pooled regional prevalence ranged from 12.6% (95% CI: 8.5, 16.7) in the Southeast Asian region to 25.3% (95% CI: 24.1, 26.4) in the Eastern Mediterranean region.

Figure 6.1. Magnitude of the intra-household double burden of overweight/obesity and anaemia by WHO region.

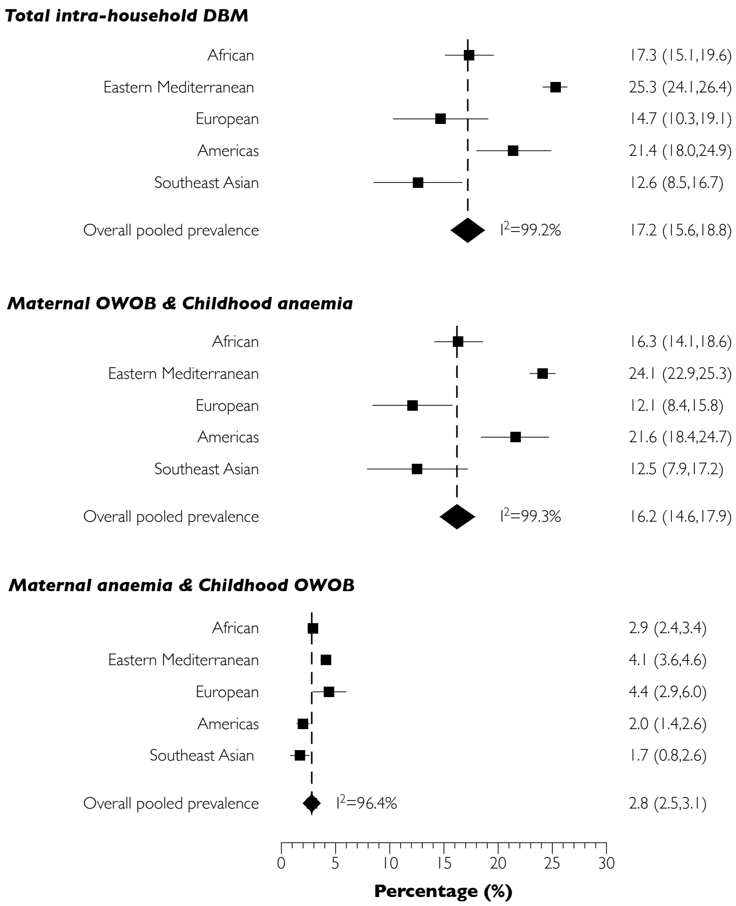


Table 6.3. Prevalence of intra-household double burden of overweight/obesity and anaemia among mothers and their children under-5.

	Mothers with OWOB & children with anaemia		Mothers with anaemia and children with OWOB		Total DBM	
Country and survey year	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n
AFRICAN REGION						
Regional prevalence	**16.3 [14.1, 18.6]**	**75,299**	**2.9 [2.4, 3.4]**	**80,931**	**17.3 [15.1, 19.6]**	**82,379**
Benin 2017-18	18.3 [16.7, 20.0]	3,352	1.1 [0.8, 1.5]	3,469	18.3 [16.8, 19.9]	3,491
Burkina Faso 2010	7.1 [6.1., 8.1]	3,849	2.4 [1.9, 3.1]	3,960	8.8 [7.8, 9.9]	4,027
Burundi 2016-17	4.2 [3.4, 5.1]	3,265	0.8 [0.6, 1.3]	3,383	4.8 [3.9, 5.7]	3,389
Cameroon 2011	19.7 [18.0, 21.6]	2,746	3.7 [3.0, 4.6]	2,870	21.3 [19.5, 23.2]	2,908
Congo 2011-12	16.5 [14.3, 19.1]	2,543	2.5 [1.8, 3.6]	2,651	17.8 [15.6, 20.3]	2,677
Cote d'Ivoire 2011-12	16.4 [14.2, 18.7]	1,812	2.7 [1.9, 3.9]	1,870	17.4 [15.2, 19.8]	1,917
DRC 2013-14	9.0 [7.7, 10.6]	3,880	3.2 [2.5, 4.2]	4,020	11.5 [10.0, 13.1]	4,085
Eswatini 2006-07	24.2 [21.9, 26.7]	1,345	4.3 [3.3, 5.6]	1,420	25.4 [23.0, 27.9]	1,448
Ethiopia 2016	3.1 [2.5, 3.8]	4,896	1.2 [0.7, 2.0]	5,157	4.1 [3.3, 5.0]	5,220
Gabon 2012	29.3 [25.6, 33.3]	1,885	7.0 [5.2, 9.4]	1,971	31.6 [28.0, 35.5]	2,020
Gambia 2013	15.3 [13.2, 17.6]	1,722	3.2 [2.2, 4.6]	1,753	16.5 [14.4, 18.9]	1,858

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity.
Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

Table 6.3. (continued)

	Mothers with OWOB & children with anaemia		Mothers with anaemia and children with OWOB		Total DBM	
Country and survey year	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n
AFRICAN REGION						
Ghana 2014	24.2 [21.8, 26.9]	1,611	1.6 [1.0, 2.4]	1,697	23.9 [21.6, 26.5]	1,716
Guinea 2018	20.8 [18.7, 23.1]	1,958	2.9 [2.2, 3.8]	2,016	21.7 [19.5, 24.0]	2,068
Lesotho 2014	22.1 [19.1, 25.3]	950	2.3 [1.5, 3.6]	1,019	21.9 [19.0, 25.1]	1,033
Malawi 2015-16	10.8 [9.4, 12.2]	3,479	1.8 [1.4, 2.4]	3,609	11.7 [10.3, 13.2]	3,651
Mali 2018	22.5 [20.3, 24.8]	2,260	1.6 [1.1, 2.3]	2,316	22.6 [20.4, 24.9]	2,356
Mozambique 2011	9.2 [7.9, 10.6]	2,750	7.7 [6.8, 8.6]	5,607	11.5 [10.5, 12.7]	5,650
Namibia 2013	16.5 [13.9, 19.4]	1,183	0.7 [0.4, 1.3]	1,278	15.3 [12.9, 17.9]	1,310
Niger 2012	15.1 [13.4, 16.9]	2,355	1.5 [1.0, 2.2]	2,427	15.3 [13.6, 17.1]	2,505
Nigeria 2018	19.2 [17.9, 20.7]	5,963	2.1 [1.7, 2.6]	6,173	20.1 [18.7, 21.5]	6,220
Rwanda 2014-15	8.8 [7.7, 10.1]	2,293	2.2 [1.7, 3.0]	2,360	10.3 [9.1, 11.6]	2,400
STP 2008-09	24.2 [20.7, 28.1]	982	8.5 [6.3, 11.3]	987	28.6 [25.2, 32.2]	1,051
Senegal 2010-11	17.4 [15.2, 19.8]	2,023	2.8 [2.0, 3.9]	2,093	18.8 [16.8, 21.0]	2,154

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity.
Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

Table 6.3. (continued)

	Mothers with OWOB & children with anaemia		**Mothers with anaemia and children with OWOB**		**Total DBM**	
Country and survey year	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n
AFRICAN REGION						
Sierra Leone 2013	12.7 [11.2, 14.4]	2,889	6.1 [5.1, 7.3]	2,864	16.7 [15.1, 18.5]	3,085
South Africa 2016	42.2 [37.2, 47.4]	665	5.3 [3.6, 7.7]	751	38.7 [34.1, 43.5]	792
Tanzania 2015-16	14.4 [13.2, 15.7]	5,107	2.4 [1.9, 3.1]	5,294	15.7 [14.4, 17.0]	5,339
Togo 2013-14	20.2 [18.2, 22.5]	1,927	1.4 [0.9, 2.2]	2,017	20.0 [18.0, 22.3]	2,035
Uganda 2016	12.1 [10.5, 13.9]	2,377	2.1 [1.6, 2.9]	2,465	13.4 [11.8, 15.2]	2,488
Zimbabwe 2015	13.6 [12.2, 15.1]	3,232	1.3 [0.9, 1.8]	3,434	13.7 [12.4, 15.1]	3,486
EASTERN MEDITERRANEAN REGION						
Regional prevalence	**24.1 [22.9, 25.3]**	**5,166**	**4.1 [3.6, 4.6]**	**5,302**	**25.3 [24.1, 26.4]**	**5,530**
Egypt 2014	25.3 [23.3, 27.3]	3,034	5.7 [4.8, 6.9]	3,054	27.9 [26.0, 29.9]	3,170
Yemen 2013	20.6 [18.6, 22.8]	2,132	3.5 [2.6, 4.8]	2,248	21.2 [19.3, 23.3]	2,360

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity.
Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

Table 6.3. (continued)

	Mothers with OWOB & children with anaemia		Mothers with anaemia and children with OWOB		Total DBM	
Country and survey year	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n
EUROPEAN REGION						
Regional prevalence	**12.1 [8.4, 15.8]**	**10,566**	**4.4 [2.9, 6.0]**	**11,237**	**14.7 [10.3, 19.1]**	**11,479**
Albania 2017-18	10.6 [8.8, 12.6]	1,583	5.2 [3.8, 7.0]	1,867	13.1 [11.2, 15.2]	1,906
Armenia 2015-16	4.7 [3.4, 6.4]	1,052	1.9 [1.2, 2.9]	1,137	5.8 [4.4, 7.4]	1,161
Azerbaijan 2006	17.1 [14.5, 19.9]	1,253	8.4 [6.9, 10.2]	1,280	21.9 [19.5, 24.5]	1,342
Kyrgyz Republic 2012	14.6 [12.9, 16.5]	2,384	5.9 [4.8, 7.2]	2,484	18.5 [16.5, 20.7]	2,524
Moldova 2005	11.7 [9.7, 14.0]	1,004	3.8 [2.7, 5.4]	1,082	13.7 [11.7, 15.9]	1,128
Tajikistan 2017	14.0 [12.6, 15.5]	3,290	2.4 [1.9, 3.0]	3,387	15.4 [14.0, 16.9]	3,418
AMERICAS REGION						
Regional prevalence	**21.6 [18.4, 24.7]**	**25,659**	**2.0 [1.4, 2.6]**	**27,234**	**21.4 [18.0, 24.9]**	**27,476**
Bolivia 2008	33.0 [29.9, 36.1]	1,649	5.3 [4.2, 6.6]	1,746	33.4 [30.4, 36.4]	1,783

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity.
Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

Table 6.3. (continued)

	Mothers with OWOB & children with anaemia		Mothers with anaemia and children with OWOB		Total DBM	
Country and survey year	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n
AMERICAS REGION						
Guatemala 2014-15	17.7 [16.6, 18.8]	7,483	0.9 [0.7, 1.2]	7,928	17.4 [16.3, 18.5]	7,960
Guyana 2009	20.5 [17.0, 24.5]	975	2.8 [1.6, 4.7]	1,049	19.5 [16.4, 23.2]	1,114
Haiti 2016-17	23.3 [21.2, 25.5]	2,393	2.3 [1.7, 3.1]	2,530	23.7 [21.6, 25.9]	2,543
Honduras 2011-12	16.1 [14.9, 17.4]	6,554	0.8 [0.6, 1.1]	7,025	15.5 [14.4, 16.7]	7,085
Peru 2012	19.4 [18.1, 20.8]	6,605	1.7 [1.3, 2.2]	6,956	19.5 [18.3, 20.8]	6,991
SOUTHEAST ASIAN REGION						
Regional prevalence	**12.5 [7.9, 17.2]**	**152,285**	**1.7 [0.8, 2.6]**	**158,487**	**12.6 [8.5, 16.7]**	**162,832**
India 2015-16	8.7 [8.4, 8.9]	145,125	1.8 [1.7, 2.0]	150,665	9.7 [9.5, 10.0]	154,792
Maldives 2016-17	30.9 [28.1, 33.9]	1,629	3.5 [2.6, 4.8]	1,842	27.9 [25.3, 30.8]	1,901
Myanmar 2015-16	15.5 [13.6, 17.5]	2,745	0.7 [0.4, 1.1]	3,089	13.6 [12.0, 15.4]	3,140

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity.
Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

Table 6.3. (continued)

	Mothers with OWOB & children with anaemia		Mothers with anaemia and children with OWOB		Total DBM	
Country and survey year	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n
SOUTHEAST ASIAN REGION						
Nepal 2016	8.3 [6.9, 10.1]	1,616	0.4 [0.2, 0.8]	1,693	8.4 [6.9, 10.1]	1,699
Timor-Leste 2016	5.8 [4.4, 7.7]	1,170	2.3 [1.5, 3.6]	1,198	7.3 [5.8, 9.2]	1,300
WESTERN PACIFIC REGION						
Regional prevalence	-	-	-	-	-	-
Cambodia 2014	9.3 [8.0, 10.7]	3,064	1.3 [0.9, 1.8]	3,223	9.7 [8.5, 11.1]	3,281
OVERALL POOLED PREVALENCE	**16.2 [14.6, 17.9]**	**272,039**	**2.8 [2.5, 3.1]**	**286,414**	**17.2 [15.6, 18.8]**	**292,977**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe; OWOB, overweight/obesity.
Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.

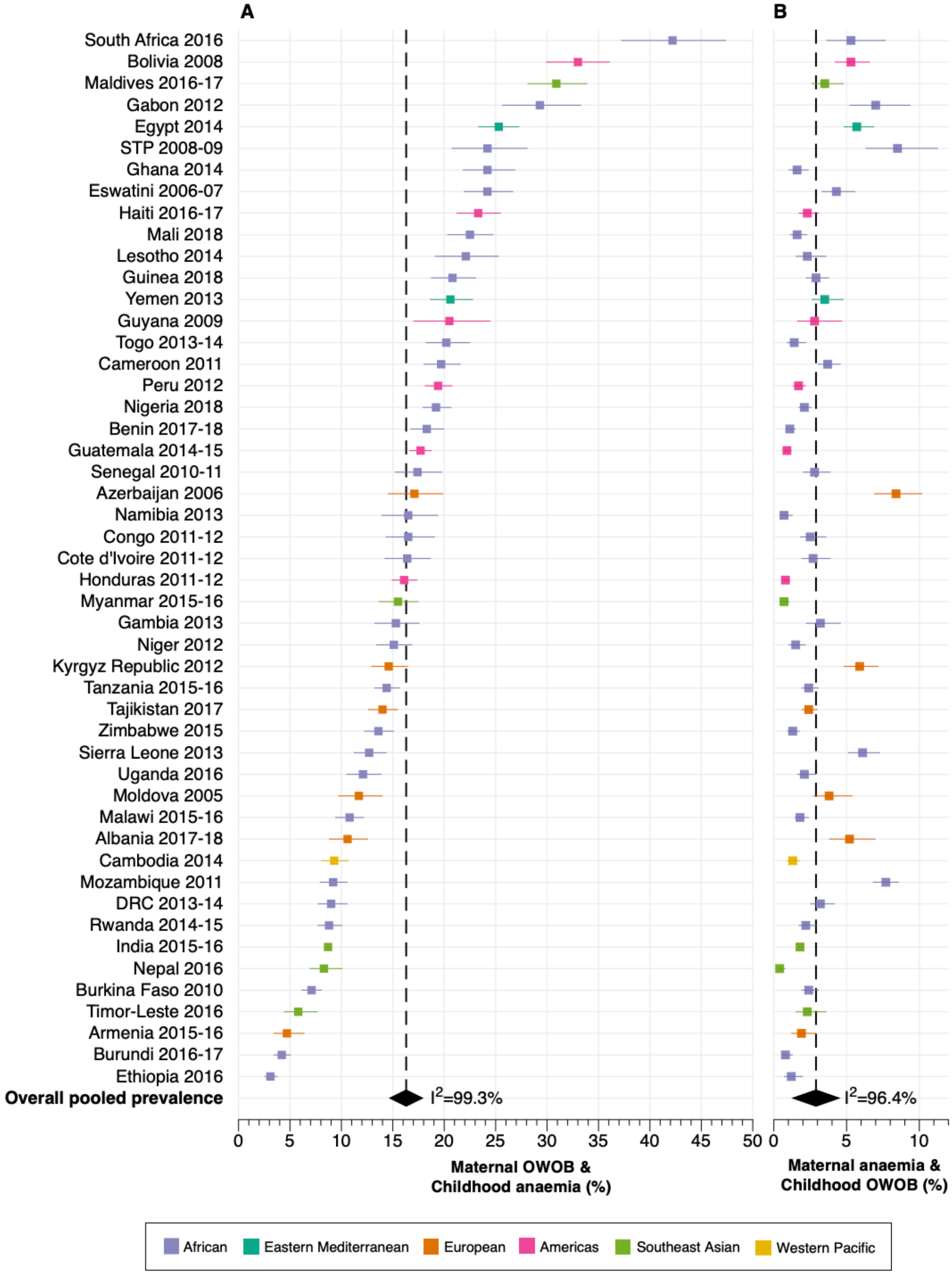
6.2.3. Households with overweight/obesity among mothers and anaemia among children

The pooled prevalence of mothers with overweight/obesity and children with anaemia was 16.2% (95% CI: 14.6, 17.9; I^2: 99.3%), ranging from 3.1% in Ethiopia to 42.2% in South Africa (**Figure 6.2** and **Table 6.3**). The pooled regional prevalence ranged from 12.1% (95% CI: 8.4, 15.8) in the European region to 24.1% (95% CI: 22.9, 25.3) in the Eastern Mediterranean region (**Figure 6.1**).

The full distribution of the magnitude of this form of intra-household DBM for all LMICs is presented in **Tables 6.4, 6.5** and **6.6**. **Figure 6.3** also displays the distribution of mothers with overweight/obesity and children with anaemia by WHO regions and overall.

Overall, the highest prevalence of mothers with overweight/obesity and children with anaemia was found in the richest household wealth quintile (21.7%), highest maternal education level (19.4%), and in urban areas (20.8%); whereas, the lowest prevalence corresponded with the lowest household wealth quintile (11.2%), lowest maternal education level (13.1%) and rural areas (14.2%) (**Figure 6.3**). By WHO region, the inverse was observed in the European region, where the prevalence was highest in the first and second wealth quintiles, and in rural areas; whilst the lowest prevalence was found in households from the fifth wealth quintile and those located in urban areas. Moreover, in the Americas region, the prevalence of DBM was highest in the third and fourth household wealth quintiles and lowest in the fourth maternal education level. In the Eastern Mediterranean region, the prevalence of DBM was also highest in the fourth wealth quintile (**Figure 6.3**).

Figure 6.2. Country-level magnitude of the intra-household double burden: A) households with overweight/obesity among mothers and anaemia among children and B) households with anaemia among mothers and overweight/obesity among children.



Note: STP: Sao Tome and Principe; DRC: Democratic Republic of the Congo; OWOB: overweight/obesity.

Table 6.4. Households with overweight/obesity among mothers and anaemia among children by household wealth.

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
Regional prevalence	**9.3 [7.6, 10.9]**	**12.7 [10.5, 14.9]**	**15.7 [13.0, 18.4]**	**20.0 [16.7, 23.3]**	**25.5 [22.7, 28.3]**	**16.2**	-
Benin 2017-18	9.5 [7.2, 12.4]	13.9 [11.2, 17.1]	14.5 [11.8, 17.8]	21.8 [18.3, 25.7]	31.1 [27.0, 35.6]	21.6	0.0000
Burkina Faso 2010	2.0 [1.2, 3.3]	3.5 [2.4, 5.2]	4.4 [3.1, 6.1]	7.3 [5.5, 9.7]	19.9 [16.6, 23.8]	17.9	0.0000
Burundi 2016-17	1.0 [0.4, 2.3]	2.0 [1.2, 3.3]	3.2 [1.9, 5.5]	5.1 [3.4, 7.6]	11.8 [8.9, 15.4]	10.8	0.0000
Cameroon 2011	6.2 [4.3, 8.9]	14.7 [11.9, 18.1]	25.4 [21.7, 29.4]	25.0 [20.9, 29.5]	27.9 [24.0, 32.2]	21.7	0.0000
Congo 2011-12	6.9 [5.3, 8.9]	15.3 [9.7, 23.3]	10.9 [7.0, 16.5]	22.1 [16.4, 28.9]	30.4 [24.1, 37.6]	23.5	0.0000
Cote d'Ivoire 2011-12	8.7 [6.1, 12.5]	11.0 [8.2, 14.7]	17.2 [13.0, 22.4]	21.8 [16.9, 27.7]	27.8 [22.3, 34.1]	19.1	0.0000
DRC 2013-14	4.6 [2.9, 7.2]	4.6 [3.0, 7.0]	7.3 [5.0, 10.7]	9.7 [6.8, 13.7]	22.8 [19.3, 26.8]	18.2	0.0000
Eswatini 2006-07	19.3 [15.1, 24.5]	20.5 [16.6, 25.0]	28.3 [23.1, 34.2]	27.7 [22.6, 33.6]	25.9 [20.8, 31.9]	6.6	0.0943
Ethiopia 2016	2.0 [1.3, 3.3]	1.0 [0.4, 2.4]	1.7 [0.9, 3.2]	2.1 [1.1, 4.0]	10.3 [8.0, 13.2]	8.3	0.0000
Gabon 2012	20.7 [16.7, 25.5]	26.8 [20.1, 34.8]	35.2 [27.3, 44.0]	35.2 [28.1, 42.9]	27.4 [21.8, 33.9]	6.7	0.0100

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.4. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
Gambia 2013	13.5 [9.8, 18.2]	13.5 [10.2, 17.6]	15.4 [11.2, 20.7]	18.5 [13.7, 24.5]	15.9 [11.6, 21.5]	2.4	0.4692
Ghana 2014	10.4 [7.9, 13.6]	19.5 [15.1, 24.7]	25.3 [20.3, 31.1]	33.0 [26.2, 40.5]	35.6 [28.2, 43.7]	25.2	0.0000
Guinea 2018	8.5 [5.9, 12.0]	16.7 [13.2, 20.9]	19.0 [15.3, 23.4]	30.7 [25.1, 36.9]	36.0 [29.9, 42.6]	27.5	0.0000
Lesotho 2014	11.4 [7.5, 17.1]	24.4 [18.4, 31.8]	25.3 [18.8, 33.1]	26.0 [18.5, 35.3]	23.4 [15.4, 33.9]	12.0	0.0288
Malawi 2015-16	8.0 [5.3, 11.8]	6.6 [5.0, 8.7]	10.2 [7.8, 13.3]	13.8 [10.8, 17.4]	17.1 [13.9, 21.0]	9.1	0.0000
Mali 2018	14.6 [10.9, 19.2]	16.2 [13.0, 20.1]	14.6 [11.4, 18.4]	30.5 [26.3, 35.1]	38.3 [33.2, 43.7]	23.7	0.0000
Mozambique 2011	2.9 [1.8, 4.8]	6.8 [4.6, 9.9]	7.0 [4.8, 10.1]	10.5 [7.8, 14.2]	20.1 [16.6, 24.1]	17.2	0.0000
Namibia 2013	9.1 [5.9, 13.6]	13.0 [9.2, 18.0]	15.9 [11.5, 21.6]	25.9 [18.8, 34.6]	20.7 [14.4, 29.0]	11.6	0.0002
Niger 2012	9.3 [6.3, 13.5]	8.9 [6.4, 12.1]	10.9 [8.1, 14.5]	13.7 [10.5, 17.8]	33.0 [28.8, 37.4]	23.7	0.0000
Nigeria 2018	6.6 [5.2, 8.3]	11.3 [9.4, 13.4]	18.4 [15.9, 21.2]	27.5 [23.8, 31.6]	29.8 [26.6, 33.2]	23.2	0.0000
Rwanda 2014-15	5.5 [3.8, 8.0]	7.7 [5.6, 10.5]	6.8 [4.7, 9.7]	12.0 [8.9, 16.1]	14.5 [11.3, 18.4]	9.0	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.4. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
STP 2008-09	21.1 [15.8, 27.6]	20.5 [15.3, 26.9]	23.3 [16.7, 31.5]	29.3 [20.2, 40.4]	27.9 [18.1, 40.4]	6.8	0.4102
Senegal 2010-11	9.9 [7.3, 13.3]	12.4 [9.5, 15.9]	19.2 [15.0, 24.2]	21.4 [16.0, 27.9]	24.8 [16.1, 36.1]	14.9	0.0047
Sierra Leone 2013	7.3 [5.4, 9.8]	9.6 [7.3, 12.5]	11.7 [9.2, 14.7]	14.7 [11.3, 18.9]	24.3 [19.7, 29.5]	17.0	0.0000
South Africa 2016	41.8 [32.5, 51.7]	46.7 [37.3, 56.4]	41.5 [32.7, 51.0]	36.5 [25.9, 48.7]	44.1 [27.3, 62.4]	2.3	0.7741
Tanzania 2015-16	7.5 [5.8, 9.6]	8.0 [6.4, 10.0]	13.1 [10.9, 15.6]	16.4 [13.7, 19.4]	28.3 [25.2, 31.6]	20.8	0.0000
Togo 2013-14	7.1 [5.0, 9.9]	12.9 [9.5, 17.1]	18.6 [14.6, 23.3]	27.9 [22.7, 33.8]	36.4 [30.5, 42.6]	29.3	0.0000
Uganda 2016	4.9 [3.3, 7.3]	8.7 [6.4, 11.8]	10.8 [8.1, 14.3]	9.4 [6.7, 13.1]	25.2 [20.0, 31.3]	20.3	0.0000
Zimbabwe 2015	8.8 [6.8, 11.2]	9.1 [6.9, 11.8]	13.1 [10.2, 16.7]	17.9 [15.1, 21.1]	20.6 [17.0, 24.7]	11.8	0.0000
EASTERN MEDITERRANEAN REGION							
Regional prevalence	**12.5 [10.6, 14.5]**	**23.5 [20.9, 26.2]**	**22.2 [19.7, 24.6]**	**28.3 [25.6, 30.9]**	**24.7 [22.1, 27.3]**	**12.2**	-
Egypt 2014	29.9 [25.6, 34.5]	27.9 [24.0, 32.2]	23.1 [19.5, 27.1]	25.8 [21.8, 30.2]	20.5 [16.5, 25.1]	-9.4	0.0291

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.4. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
EASTERN MEDITERRANEAN REGION							
Yemen 2013	5.7 [3.7, 8.8]	13.8 [10.6, 17.8]	20.2 [15.9, 25.4]	30.9 [25.8, 36.5]	32.9 [27.8, 38.5]	27.2	0.0000
EUROPEAN REGION							
Regional prevalence	**13.2 [9.5, 16.9]**	**13.2 [7.9, 18.4]**	**12.2 [8.9, 15.5]**	**11.7 [7.8, 15.6]**	**9.4 [5.6, 13.2]**	**-3.8**	**-**
Albania 2017-18	12.2 [9.2, 15.9]	12.1 [8.8, 16.4]	13.2 [8.8, 19.3]	7.3 [4.5, 11.6]	6.4 [2.6, 15.2]	-5.8	0.1756
Armenia 2015-16	5.5 [3.1, 9.5]	3.7 [1.6, 8.2]	6.3 [3.4, 11.4]	4.1 [1.9, 8.5]	4.1 [1.6, 10.0]	-1.4	0.7801
Azerbaijan 2006	15.5 [11.7, 20.1]	17.8 [14.3, 21.9]	18.9 [14.7, 23.8]	17.2 [13.1, 22.1]	16.0 [12.9, 19.7]	0.5	0.9128
Kyrgyz Republic 2012	16.5 [13.0, 20.6]	17.5 [14.2, 21.3]	10.4 [7.6, 14.0]	15.1 [11.8, 19.1]	13.8 [9.0, 20.5]	-2.7	0.1171
Moldova 2005	13.3 [9.1, 18.9]	13.7 [9.8, 18.8]	11.7 [8.9, 15.2]	13.8 [11.7, 16.2]	6.4 [3.8, 10.5]	-6.9	0.1460
Tajikistan 2017	15.8 [12.4, 19.9]	13.4 [10.5, 16.9]	14.3 [11.6, 17.5]	14.0 [11.1, 17.4]	12.3 [10.1, 14.9]	-3.5	0.6331

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.4. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AMERICAS REGION							
Regional prevalence	**18.3 [14.8, 21.8]**	**20.6 [16.6, 24.5]**	**24.4 [20.7, 28.1]**	**23.9 [18.7, 29.0]**	**19.8 [14.8, 24.7]**	**1.5**	**-**
Bolivia 2008	26.5 [22.0, 31.5]	34.0 [28.5, 39.9]	42.1 [34.9, 49.7]	34.5 [28.6, 40.8]	25.6 [19.1, 33.4]	-0.9	0.0015
Guatemala 2014-15	16.9 [14.8, 19.2]	17.1 [15.1, 19.2]	20.0 [17.4, 22.7]	18.1 [16.0, 20.4]	16.1 [13.6, 18.9]	-0.8	0.1886
Guyana 2009	21.8 [14.5, 31.3]	20.2 [13.6, 28.9]	19.6 [13.7, 27.3]	21.7 [14.8, 30.6]	18.5 [11.6, 28.2]	-3.3	0.9686
Haiti 2016-17	12.7 [9.5, 16.8]	14.0 [11.0, 17.7]	24.6 [20.5, 29.4]	35.5 [30.6, 40.7]	31.8 [26.3, 37.7]	19.1	0.0000
Honduras 2011-12	13.8 [12.2, 15.7]	15.7 [13.7, 17.8]	19.6 [17.0, 22.5]	17.2 [14.3, 20.5]	14.1 [11.0, 18.0]	0.3	0.0148
Peru 2012	21.0 [18.6, 23.6]	21.8 [19.6, 24.1]	21.8 [18.9, 25.1]	18.3 [15.0, 22.1]	10.2 [7.4, 14.0]	-10.8	0.0000
SOUTHEAST ASIAN REGION							
Regional prevalence	**8.6 [3.7, 13.6]**	**10.6 [5.1, 16.0]**	**12.8 [7.3, 18.4]**	**14.3 [9.7, 18.9]**	**16.8 [12.9, 20.8]**	**8.2**	-
India 2015-16	2.6 [2.4, 2.8]	5.3 [5.0, 5.7]	9.0 [8.5, 9.6]	12.8 [12.2, 13.5]	16.2 [15.5, 17.1]	13.6	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.4. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION							
Maldives 2016-17	26.8 [22.6, 31.4]	29.7 [25.4, 34.5]	27.4 [22.5, 33.0]	44.0 [35.1, 53.3]	30.8 [18.5, 46.6]	4.0	0.0169
Myanmar 2015-16	9.4 [6.7, 12.9]	14.0 [11.0, 17.6]	18.7 [14.8, 23.3]	18.0 [13.8, 23.0]	23.5 [17.9, 30.2]	14.1	0.0000
Nepal 2016	6.4 [3.5, 11.6]	3.8 [2.3, 6.4]	5.1 [3.1, 8.1]	11.1 [7.8, 15.5]	18.9 [13.6, 25.5]	12.5	0.0000
Timor-Leste 2016	2.9 [1.3, 6.5]	4.3 [2.0, 8.8]	6.2 [3.5, 10.5]	6.0 [3.2, 11.1]	10.0 [6.3, 15.5]	7.1	0.0576
WESTERN PACIFIC REGION							
Regional prevalence	-	-	-	-	-	-	-
Cambodia 2014	7.0 [5.1, 9.6]	10.9 [8.2, 14.3]	10.2 [7.0, 14.6]	9.1 [6.7, 12.2]	9.8 [7.0, 13.5]	2.8	0.3414
OVERALL POOLED PREVALENCE	**11.2 [9.6, 12.7]**	**13.9 [12.1, 15.7]**	**16.1 [14.3, 18.0]**	**19.0 [17.0, 21.0]**	**21.7 [19.7, 23.7]**	**10.5**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.5. Households with overweight/obesity among mothers and anaemia among children by maternal education level.

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AFRICAN REGION						
Regional prevalence	**12.1 [9.4, 14.8]**	**14.6 [12.2, 17.0]**	**18.9 [16.4, 21.4]**	**22.6 [18.4, 26.9]**	**10.5**	**-**
Benin 2017-18	16.4 [14.5, 18.5]	20.5 [17.3, 24.2]	21.6 [18.0, 25.6]	41.9 [29.1, 55.9]	25.5	0.0000
Burkina Faso 2010¶	5.0 [4.2, 5.9]	14.7 [11.4, 18.6]	19.8 [14.4, 26.6]	-	-	-
Burundi 2016-17	2.7 [1.9, 3.8]	4.7 [3.2, 6.7]	8.4 [5.8, 12.0]	8.4 [3.0, 21.3]	5.7	0.0006
Cameroon 2011	8.3 [6.2, 11.2]	20.8 [18.3, 23.5]	26.7 [23.6, 30.1]	28.3 [20.1, 38.3]	20.0	0.0000
Congo 2011-12	13.7 [8.0, 22.7]	12.4 [9.1, 16.6]	17.9 [15.1, 21.0]	33.8 [18.3, 53.9]	20.1	0.0038
Cote d'Ivoire 2011-12¶	14.6 [12.0, 17.7]	18.9 [14.8, 23.7]	20.2 [14.0, 28.4]	-	-	-
DRC 2013-14	4.6 [2.9, 7.2]	8.4 [6.5, 10.6]	11.6 [9.6, 14.1]	22.3 [11.5, 38.8]	17.7	0.0000
Eswatini 2006-07	17.3 [13.6, 21.8]	25.8 [21.8, 30.2]	24.9 [21.9, 28.1]	18.3 [10.9, 28.9]	1.0	0.2049
Ethiopia 2016	2.0 [1.5, 2.8]	3.8 [2.6, 5.4]	7.1 [4.4, 11.4]	15.0 [8.6, 24.8]	13.0	0.0000
Gabon 2012	30.8 [18.2, 47.3]	32.1 [27.1, 37.6]	27.9 [23.6, 32.6]	29.5 [18.5, 43.4]	-1.3	0.6963

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.5. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AFRICAN REGION						
Gambia 2013	16.4 [13.7, 19.5]	13.4 [8.5, 20.5]	15.2 [11.1, 20.5]	1.0 [0.1, 7.5]	-15.4	0.1096
Ghana 2014	15.8 [12.8, 19.4]	25.1 [20.2, 30.8]	27.4 [23.1, 32.1]	43.8 [22.0, 68.2]	28.0	0.0014
Guinea 2018	19.0 [16.8, 21.4]	21.0 [15.8, 27.4]	32.2 [25.1, 40.3]	27.5 [13.9, 47.2]	8.5	0.0008
Lesotho 2014¶	-	19.8 [15.6, 24.7]	22.7 [17.9, 28.2]	33.4 [22.3, 46.8]	-	-
Malawi 2015-16	15.5 [11.8, 20.1]	9.2 [7.8, 10.9]	12.4 [9.7, 15.8]	12.3 [5.2, 26.6]	-3.2	0.0072
Mali 2018	19.9 [17.4, 22.6]	24.8 [19.4, 31.1]	33.0 [27.8, 38.5]	33.7 [17.7, 54.4]	13.8	0.0001
Mozambique 2011	6.2 [4.8, 8.0]	10.1 [8.3, 12.4]	12.9 [9.6, 17.1]	14.0 [6.0, 29.4]	7.8	0.0006
Namibia 2013	14.1 [8.5, 22.5]	12.9 [9.5, 17.3]	18.0 [14.6, 21.9]	15.0 [7.9, 26.7]	0.9	0.2814
Niger 2012¶	13.6 [11.9, 15.6]	19.9 [15.4, 25.3]	28.2 [21.0, 36.7]	-	-	-
Nigeria 2018	10.7 [9.2, 12.4]	20.5 [16.3, 25.4]	23.8 [21.8, 25.9]	32.0 [27.4, 36.9]	21.3	0.0000
Rwanda 2014-15	5.7 [3.7, 8.7]	8.7 [7.3, 10.3]	13.7 [9.6, 19.1]	11.3 [5.7, 21.2]	5.6	0.0131

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.5. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AFRICAN REGION						
STP 2008-09¶	24.3 [11.1, 45.2]	23.7 [19.6, 28.2]	26.3 [18.3, 36.3]	-	-	-
Senegal 2010-11¶	15.1 [12.8, 17.8]	22.5 [17.1, 29.0]	22.0 [14.7, 31.6]	-	-	-
Sierra Leone 2013	12.5 [10.7, 14.6]	10.4 [7.6, 14.3]	15.2 [11.5, 20.0]	15.8 [8.7, 27.2]	3.3	0.3007
South Africa 2016¶	-	37.9 [28.4, 48.5]	44.0 [38.3, 49.7]	39.5 [24.9, 56.3]	-	-
Tanzania 2015-16	10.2 [8.3, 12.5]	14.2 [12.7, 15.9]	19.6 [16.8, 22.8]	34.2 [20.1, 51.8]	24.0	0.0000
Togo 2013-14¶	14.6 [12.2, 17.3]	23.5 [19.8, 27.7]	23.6 [18.5, 29.5]	-	-	-
Uganda 2016	11.0 [7.5, 16.0]	9.4 [7.6, 11.5]	18.5 [14.8, 22.9]	16.8 [10.5, 25.7]	5.8	0.0001
Zimbabwe 2015	9.6 [4.3, 20.0]	9.4 [7.5, 11.6]	15.3 [13.4, 17.4]	19.9 [14.2, 27.1]	10.3	0.0001
EASTERN MEDITERRANEAN REGION						
Regional prevalence	-	-	-	-	-	-
Egypt 2014	23.4 [19.5, 27.9]	27.9 [21.8, 35.0]	25.9 [23.4, 28.5]	23.3 [19.1, 28.1]	-0.1	0.5061

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.5. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
EASTERN MEDITERRANEAN REGION						
Yemen 2013§	-	-	-	-	-	-
EUROPEAN REGION						
Regional prevalence	-	-	-	-	-	-
Albania 2017-18¶	-	13.3 [10.8, 16.3]	6.3 [4.4, 9.0]	9.5 [5.9, 14.8]	-	-
Armenia 2015-16¶	-	3.7 [1.0, 12.6]	5.8 [3.7, 9.0]	3.9 [2.4, 6.4]	-	-
Azerbaijan 2006¶	-	-	16.8 [14.1, 19.8]	17.2 [11.9, 24.3]	-	-
Kyrgyz Republic 2012¶	-	-	15.4 [13.1, 18.0]	13.5 [11.1, 16.3]	-	-
Moldova 2005¶	-	-	11.7 [9.7, 14.1]	11.1 [9.4, 13.1]	-	-
Tajikistan 2017	17.0 [9.5, 28.5]	18.7 [13.1, 25.8]	13.8 [12.2, 15.7]	12.5 [9.7, 16.0]	-4.5	0.2965

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.5. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AMERICAS REGION						
Regional prevalence	**20.8 [15.9, 25.7]**	**21.9 [18.6, 25.3]**	**21.8 [17.5, 26.2]**	**19.8 [16.2, 23.4]**	**-1.0**	**-**
Bolivia 2008	38 6 [25.6, 53.5]	32.3 [28.3, 36.5]	37.1 [31.7, 42.8]	24.4 [18.5, 31.4]	-14.2	0.0372
Guatemala 2014-15	19.2 [16.6, 22.2]	18.4 [17.0, 19.9]	15.7 [13.8, 17.8]	15.8 [12.0, 20.5]	-3.4	0.0784
Guyana 2009	22.3 [8.8, 45.8]	22.6 [14.8, 32.8]	20.1 [16.4, 24.3]	17.5 [7.0, 37.3]	-4.8	0.8714
Haiti 2016-17	14.1 [10.8, 18.2]	24.6 [21.5, 27.9]	25.7 [22.4, 29.3]	30.9 [19.3, 45.4]	16.8	0.0004
Honduras 2011-12	19.7 [15.4, 24.8]	17.6 [16.2, 19.2]	12.6 [10.8, 14.7]	17.5 [12.1, 24.7]	-2.2	0.0007
Peru 2012	26.8 [20.6, 34.2]	21.7 [19.5, 24.1]	20.4 [18.5, 22.6]	13.8 [11.6, 16.3]	-13.0	0.0000
SOUTHEAST ASIAN REGION						
Regional prevalence	**6.4 [4.0, 8.8]**	**12.7 [6.8, 18.7]**	**12.9 [7.7, 18.1]**	**14.9 [10.8, 18.9]**	**8.5**	-
India 2015-16	5.1 [4.8, 5.4]	6.7 [6.2, 7.3]	9.9 [9.6, 10.3]	14.5 [13.6, 15.4]	9.4	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.5. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION						
Maldives 2016-17	34.5 [12.5, 65.9]	34.9 [28.7, 41.7]	31.2 [27.5, 35.2]	25.3 [19.3, 32.4]	-9.2	0.2277
Myanmar 2015-16	10.4 [7.0, 15.1]	16.1 [13.4, 19.1]	14.8 [11.9, 18.4]	23.5 [16.9, 31.6]	13.1	0.0162
Nepal 2016	7.4 [5.3, 10.3]	7.6 [4.7, 12.0]	9.6 [7.0, 13.1]	8.6 [5.3, 13.5]	1.2	0.6793
Timor-Leste 2016	3.9 [1.8, 8.0]	4.2 [2.0, 8.3]	6.8 [4.7, 9.7]	10.0 [4.4, 20.9]	6.1	0.1715
WESTERN PACIFIC REGION						
Regional prevalence	-	-	-	-	-	-
Cambodia 2014	9.3 [6.6, 13.1]	10.0 [8.2, 12.2]	7.5 [5.6, 9.8]	15.0 [8.0, 26.3]	5.7	0.1701
OVERALL POOLED PREVALENCE	**13.1 [11.3, 15.0]**	**15.9 [13.8, 18.0]**	**18.3 [16.0, 20.6]**	**19.4 [17.3, 21.6]**	**6.3**	-

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.6. Households with overweight/obesity among mothers and anaemia among children by area of residence.

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Regional prevalence	**22.9 [20.6, 25.2]**	**13.3 [11.2, 15.3]**	**9.6**	0.0000
Benin 2017-18	25.0 [22.2, 28.1]	14.0 [12.3, 15.9]	11.0	0.0000
Burkina Faso 2010	19.4 [16.1, 23.2]	4.1 [3.4, 5.0]	15.3	0.0000
Burundi 2016-17	15.1 [11.0, 20.5]	3.0 [2.3, 3.9]	12.1	0.0000
Cameroon 2011	25.8 [23.1, 28.8]	14.4 [12.4, 16.7]	11.4	0.0000
Congo 2011-12	21.8 [18.3, 25.7]	7.8 [6.5, 9.3]	14.0	0.0000
Cote d'Ivoire 2011-12	24.4 [20.6, 28.6]	11.2 [8.9, 14.1]	13.2	0.0000
DRC 2013-14	17.4 [14.6, 20.7]	5.4 [4.2, 6.9]	12.0	0.0000
Eswatini 2006-07	24.2 [19.1, 30.2]	24.2 [21.6, 27.0]	0.0	0.9854
Ethiopia 2016	12.4 [9.4, 16.1]	1.8 [1.3, 2.4]	10.6	0.0000
Gabon 2012	30.5 [26.3, 35.1]	21.5 [18.5, 24.9]	9.0	0.0010

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 6.6. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Gambia 2013	15.1 [11.8, 19.0]	15.5 [13.0, 18.4]	-0.4	0.8353
Ghana 2014	30.9 [27.0, 35.1]	18.3 [15.6, 21.4]	12.6	0.0000
Guinea 2018	33.8 [28.8, 39.1]	15.7 [13.6, 18.0]	18.1	0.0000
Lesotho 2014	21.4 [15.3, 29.1]	22.3 [19.0, 25.9]	-0.9	0.8169
Malawi 2015-16	18.1 [13.8, 23.5]	9.5 [8.2, 11.1]	8.6	0.0001
Mali 2018	38.0 [33.3, 42.9]	18.1 [15.9, 20.7]	19.9	0.0000
Mozambique 2011	12.1 [9.9, 14.8]	7.9 [6.5, 9.7]	4.2	0.0032
Namibia 2013	21.6 [17.0, 27.1]	12.3 [9.9, 15.2]	9.3	0.0005
Niger 2012	36.4 [31.9, 41.1]	11.2 [9.5, 13.1]	25.2	0.0000
Nigeria 2018	25.2 [22.9, 27.7]	14.4 [13.0, 15.8]	10.8	0.0000
Rwanda 2014-15	14.5 [11.6, 18.0]	7.7 [6.5, 9.2]	6.8	0.0000

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 6.6. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
STP 2008-09	27.4 [22.2, 33.2]	20.3 [15.9, 25.6]	7.1	0.0555
Senegal 2010-11	25.2 [21.2, 29.6]	11.7 [9.8, 13.9]	13.5	0.0000
Sierra Leone 2013	21.2 [17.5, 25.5]	9.8 [8.3, 11.5]	11.4	0.0000
South Africa 2016	43.3 [35.7, 51.2]	40.8 [35.0, 46.9]	2.5	0.6132
Tanzania 2015-16	23.1 [20.4, 26.1]	10.8 [9.7, 12.1]	12.3	0.0000
Togo 2013-14	31.1 [27.1, 35.5]	14.1 [12.0, 16.4]	17.0	0.0000
Uganda 2016	20.1 [15.5, 25.6]	9.8 [8.3, 11.5]	10.3	0.0000
Zimbabwe 2015	19.2 [16.5, 22.2]	11.2 [9.6, 12.9]	8.0	0.0000
EASTERN MEDITERRANEAN REGION				
Regional prevalence	**26.3 [24.3, 28.3]**	**22.1 [20.7, 23.5]**	**4.2**	**-**
Egypt 2014	23.1 [19.9, 26.6]	26.3 [23.9, 28.9]	-3.2	0.1296

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 6.6. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
EASTERN MEDITERRANEAN REGION				
Yemen 2013	32.7 [28.2, 37.5]	15.1 [13.2, 17.3]	17.6	0.0000
EUROPEAN REGION				
Regional prevalence	**11.0 [7.3, 14.8]**	**12.9 [9.3, 16.4]**	**-1.9**	**-**
Albania 2017-18	8.8 [6.4, 12.1]	12.5 [10.3, 15.2]	-3.7	0.0612
Armenia 2015-16	4.9 [3.1, 7.6]	4.5 [2.9, 7.0]	0.4	0.7923
Azerbaijan 2006	19.5 [15.8, 23.7]	14.5 [11.2, 18.5]	5.0	0.0681
Kyrgyz Republic 2012	14.8 [11.1, 19.5]	14.5 [12.7, 16.5]	0.3	0.8915
Moldova 2005	7.7 [5.8, 10.1]	14.0 [11.2, 17.4]	-6.3	0.0009
Tajikistan 2017	12.7 [10.8, 14.9]	14.3 [12.7, 16.2]	-1.6	0.2408

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 6.6. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AMERICAS REGION				
Regional prevalence	**23.3 [19.1, 27.4]**	**20.4 [17.6, 23.3]**	**2.9**	**-**
Bolivia 2008	34.5 [30.2, 39.2]	30.9 [27.1, 35.1]	3.6	0.2395
Guatemala 2014-15	17.8 [16.1, 19.7]	17.6 [16.2, 19.1]	0.2	0.8468
Guyana 2009	23.9 [16.4, 33.5]	19.5 [15.6, 24.0]	4.4	0.3332
Haiti 2016-17	30.1 [26.5, 34.0]	19.4 [16.9, 22.2]	10.7	0.0000
Honduras 2011-12	16.5 [14.7, 18.5]	15.8 [14.3, 17.4]	0.7	0.5488
Peru 2012	18.2 [16.5, 19.9]	21.9 [19.8, 24.1]	-3.7	0.0074
SOUTHEAST ASIAN REGION				
Regional prevalence	**15.2 [10.8, 19.5]**	**11.4 [6.0, 16.9]**	**3.8**	**-**
India 2015-16	14.3 [13.7, 14.9]	6.3 [6.1, 6.5]	8.0	0.0000

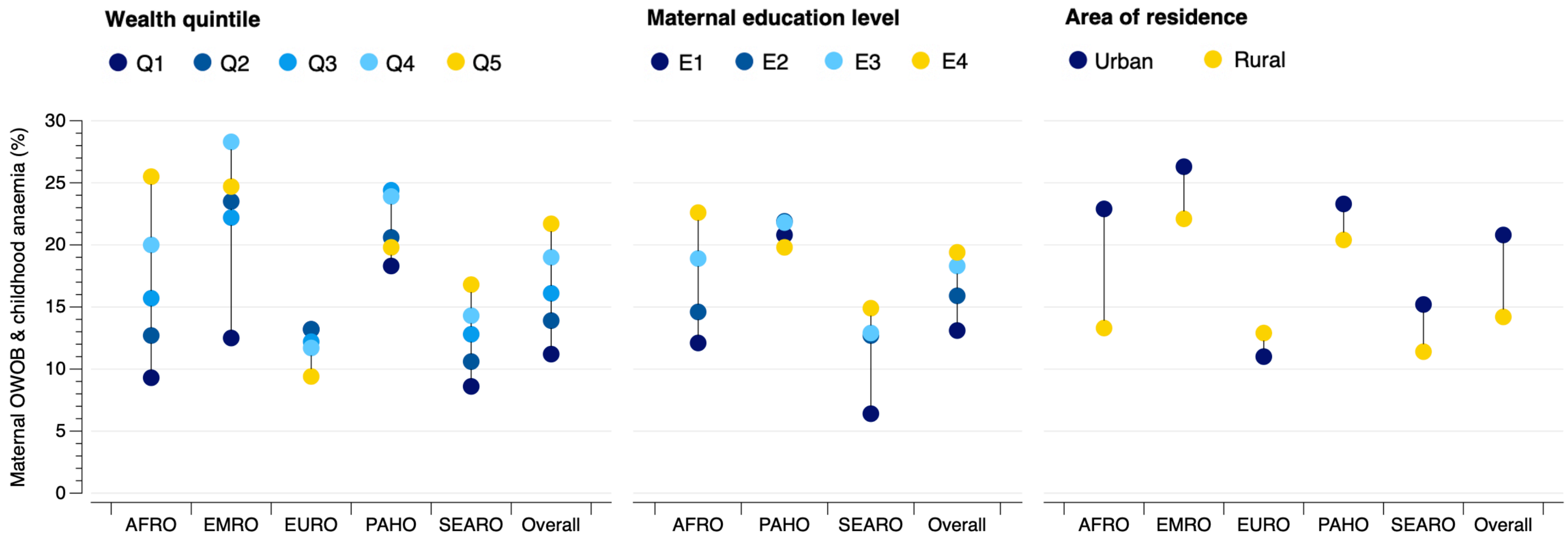
DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 6.6. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION				
Maldives 2016-17	41.9 [33.3, 50.9]	27.0 [24.7, 29.5]	14.9	0.0005
Myanmar 2015-16	20.5 [15.8, 26.2]	14.1 [12.2, 16.2]	6.4	0.0126
Nepal 2016	9.6 [7.4, 12.4]	6.8 [5.0, 9.3]	2.8	0.0959
Timor-Leste 2016	9.0 [5.5, 14.3]	4.6 [3.2, 6.5]	4.4	0.0267
WESTERN PACIFIC REGION				
Regional prevalence	**-**	**-**	**-**	**-**
Cambodia 2014	10.3 [7.9, 13.4]	9.1 [7.7, 10.7]	1.2	0.4243
OVERALL POOLED PREVALENCE	**20.8 [18.9, 22.7]**	**14.2 [12.7, 15.7]**	**6.6**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Figure 6.3. Distribution of the intra-household DBM (mothers with overweight/obesity and children with anaemia) by household wealth quintile, maternal education level and area of residence across WHO regions and overall.



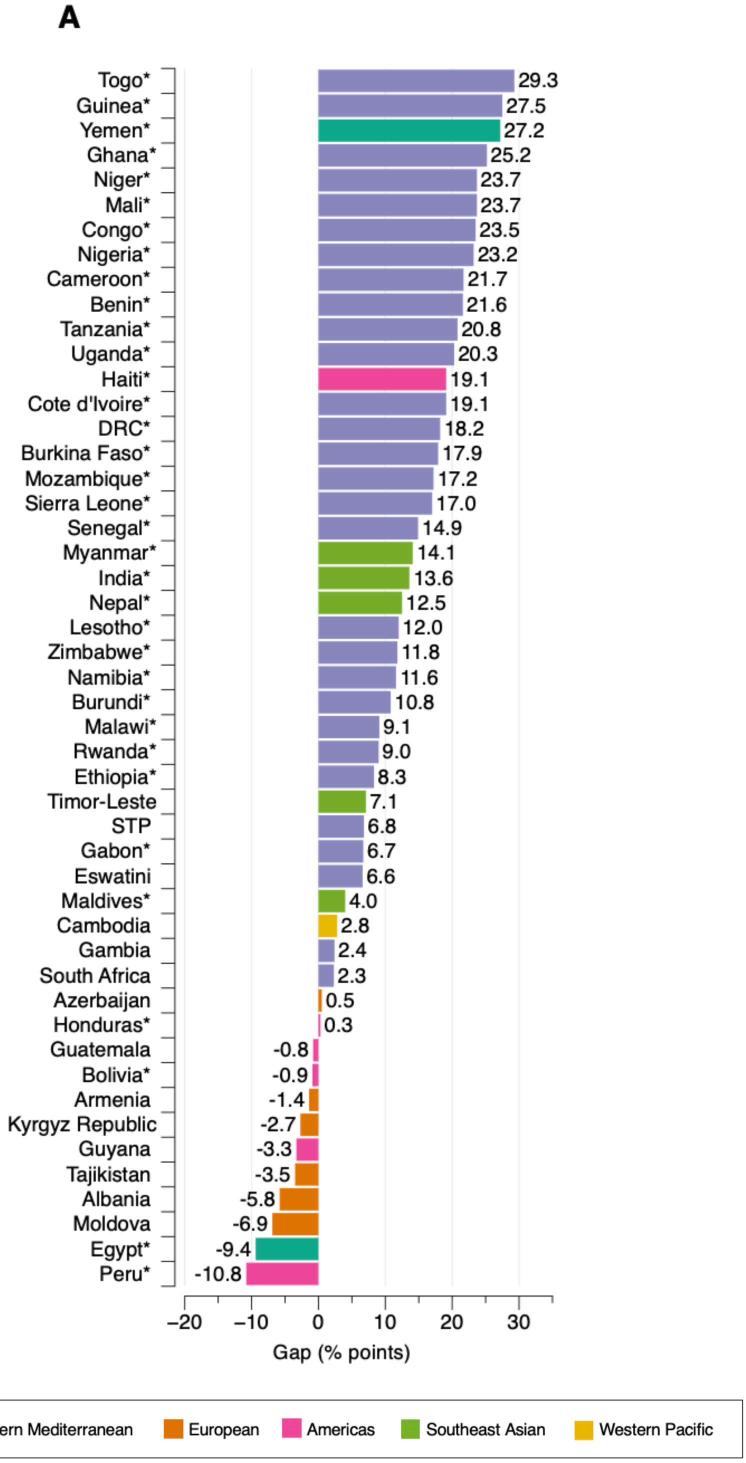
Note: OWOB: overweight/obesity; AFRO: African region; EMRO: Eastern Mediterranean region; EURO: European region; PAHO: Americas region; SEARO: Southeast Asian region. Wealth quintiles: Q1 (poorest), Q2 (poorer), Q3 (middle), Q4 (richer), Q5 (richest). Maternal education levels: E1 (no education); E2 (primary education); E3 (secondary education), E4 (higher education). The EMRO and EURO regions are missing for maternal education level, as 1/2 and 5/6 countries, respectively, had sample sizes below 25 observations for one or two education levels; and thus, the regional pooled prevalence could not be calculated. All countries with sample sizes above 25 observations for the five wealth quintiles, four maternal education levels and urban/rural areas were included in the calculation of the overall pooled prevalence estimates.

Figure 6.4 shows the absolute inequality of the prevalence of households with overweight/obesity among mothers and anaemia among children by the three socioeconomic measures and by LMICs. Large inequalities were observed in the distribution of this combination, particularly by household wealth, with 12 countries showing a difference higher than 20 pp between the fifth and first wealth quintiles (**Figure 6.4 A**). The largest gaps were observed in Togo, with a 29.3 pp difference ($p<0.001$) in intra-household DBM prevalence by household wealth (Q1, 7.1%; Q5, 36.4%); Ghana, with a 28.0 pp difference ($p=0.001$) by maternal education level (E1, 15.8%; E4, 43.8%); and in Niger, with a 25.2 pp difference ($p<0.001$) by area of residence (Urban, 36.4%; Rural, 11.2%).

Gaps were positive in 79.6% (39/49), 68.6% (24/35) and 83.7% (41/49) of countries by household wealth quintile, maternal education level and area of residence, respectively (**Figure 6.4**). This indicates that for most LMICs, households with overweight/obesity among mothers and anaemia among children were most commonly found among the richest wealth quintile, highest maternal education level and in urban areas, when compared to the poorest wealth quintile, lowest maternal education level and rural areas. Negative gaps depicting the opposite (i.e., higher prevalence of intra-household DBM in the poorest wealth quintile, lowest maternal education level and in rural areas), were observed in a low number of LMICs: 20.4% (10/49) by household wealth quintile, 31.4% (11/35) by maternal education level, and 14.3% (7/49) by area of residence. For one African country (Eswatini), the prevalence of intra-household DBM was the same in urban and rural areas (24.2%), and thus, the inequality gap was 0.0 pp by area of residence (**Figure 6.4 C**).

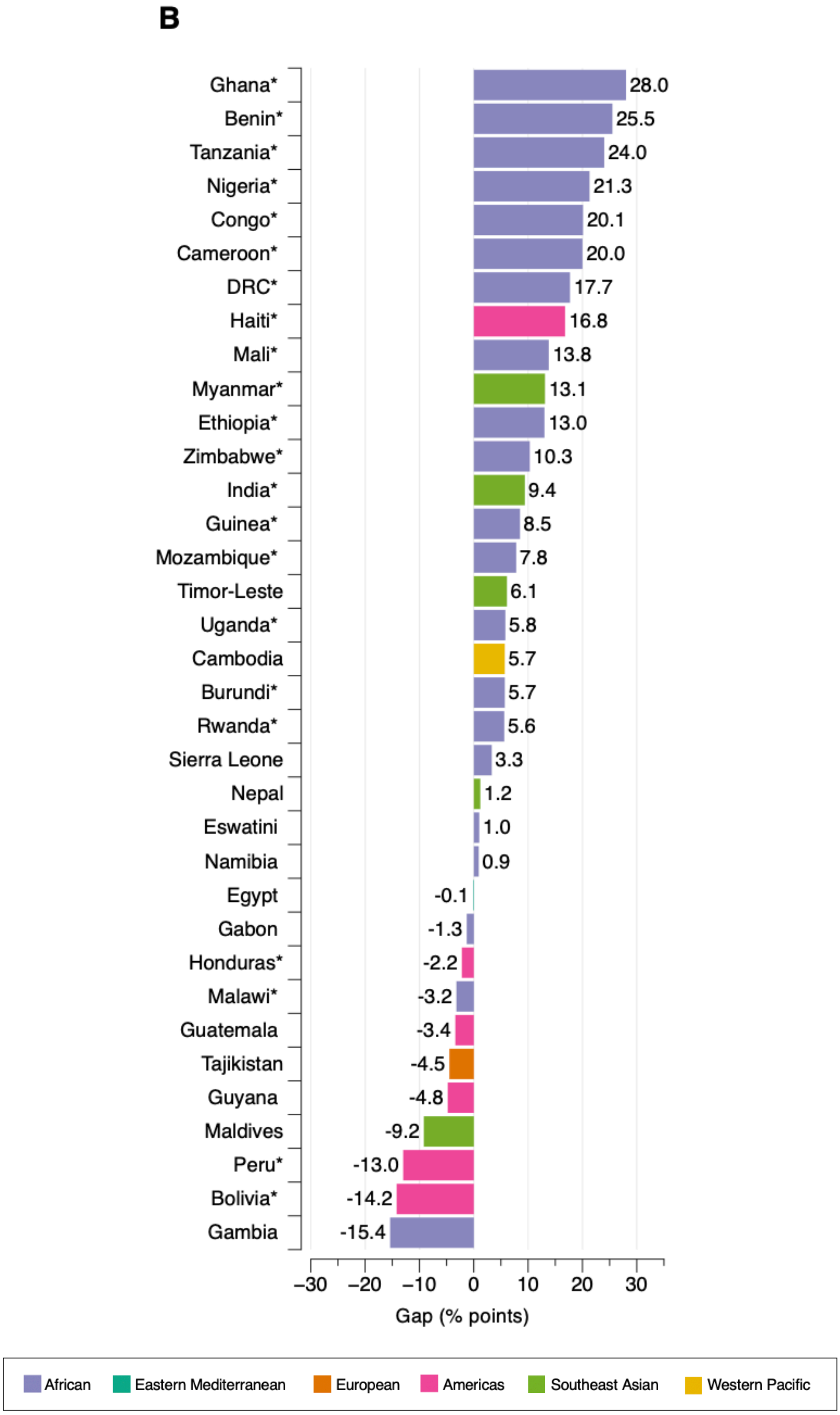
Differences observed across groups were statistically significant in 71.4% (35/49), 62.9% (22/35) and 65.3% (32/49) of countries by household wealth, maternal education level and area of residence, respectively (**Figure 6.4** and **Tables 6.4, 6.5.** and **6.6**).

Figure 6.4. Absolute gap difference of households with overweight/obesity among mothers and anaemia among children by wealth quintile (A), maternal education level (B) and area of residence (C).



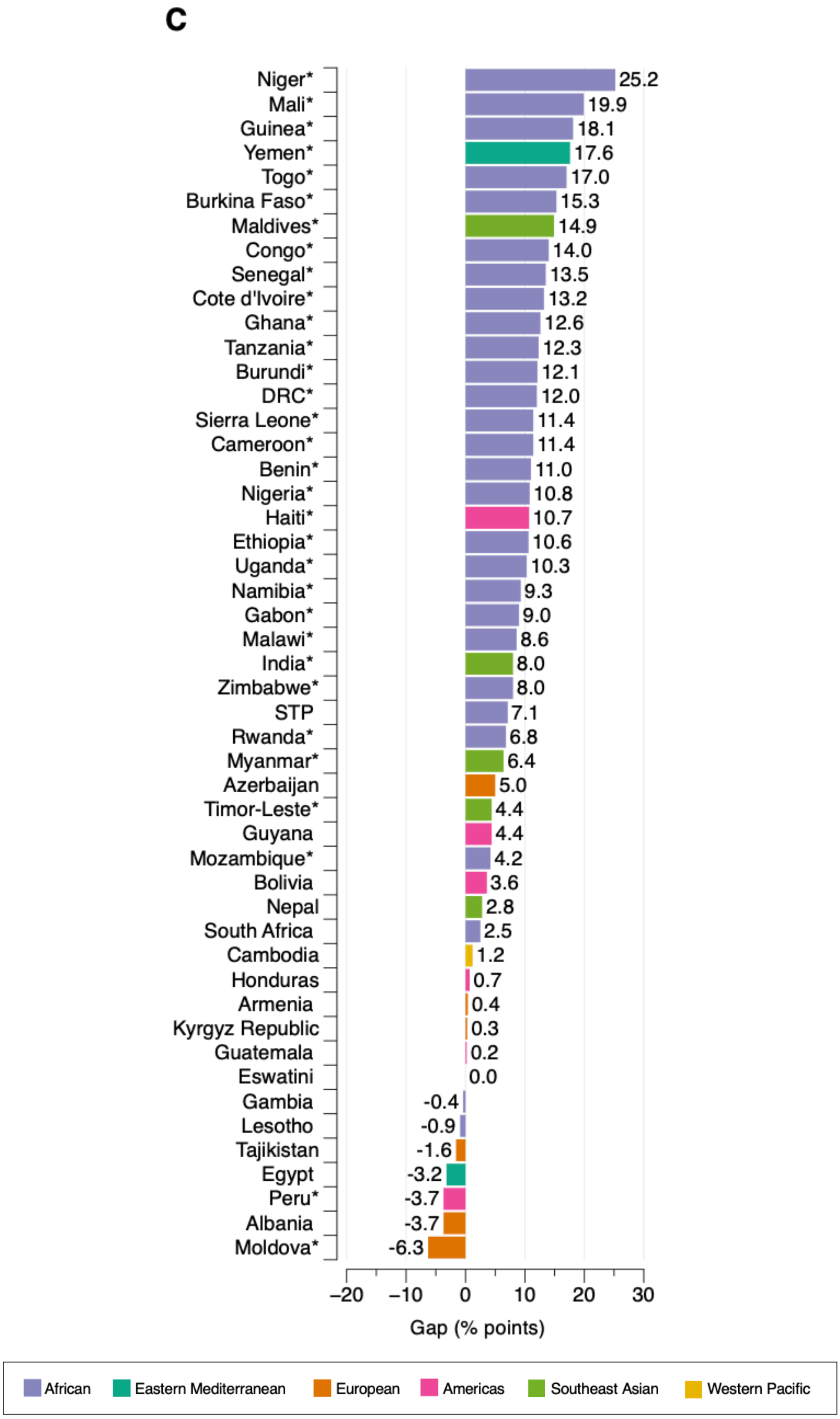
Note: Positive values mean that intra-household DBM is more prevalent in the richest quintile (Q5), highest maternal education level (E4) and in urban areas when compared to the poorest quintile (Q1), lowest maternal education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. Note that in figure B, countries with a sample size <25 observations for E1 or E4 were excluded. STP: Sao Tome and Principe; DRC: Democratic Republic of the Congo.

Figure 6.4. (continued)



Note: Positive values mean that intra-household DBM is more prevalent in the richest quintile (Q5), highest maternal education level (E4) and in urban areas when compared to the poorest quintile (Q1), lowest maternal education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. Note that in figure B, countries with a sample size <25 observations for E1 or E4 were excluded. STP: Sao Tome and Principe; DRC: Democratic Republic of the Congo.

Figure 6.4. (continued)



Note: Positive values mean that intra-household DBM is more prevalent in the richest quintile (Q5), highest maternal education level (E4) and in urban areas when compared to the poorest quintile (Q1), lowest maternal education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. Note that in figure B, countries with a sample size <25 observations for E1 or E4 were excluded. STP: Sao Tome and Principe; DRC: Democratic Republic of the Congo.

6.2.4 Households with anaemia among mothers and overweight/obesity among children

The pooled prevalence of mothers with anaemia and children with overweight/obesity was 2.8% (95% CI: 2.5, 3.1; I^2: 96.4%), ranging from 0.4% in Nepal to 8.5% in Sao Tome and Principe (**Figure 6.2**). The pooled regional prevalence was lowest in the Southeast Asian region, with a 1.7% (95% CI: 0.8, 2.6) prevalence of intra-household DBM, and highest in the European region, with a 4.4% (95% CI: 2.9, 6.0) prevalence (**Figure 6.1** and **Table 6.3**).

Overall, the prevalence of mothers with anaemia and children with overweight/obesity was significantly lower than mothers with overweight/obesity and children with anaemia, with an overall difference of 13.4 pp between both intra-household DBM forms (**Figure 6.2**). Only in six countries, the prevalence of DBM was similar for both forms (difference <5 pp), although higher for mothers with overweight/obesity and children with anaemia, including in Burkina Faso (7.1% vs. 2.4%), Burundi (4.2% vs. 0.8%), Ethiopia (3.1% vs. 1.2%), Mozambique (9.2% vs. 7.7%), Armenia (4.7% vs. 1.9%) and Timor-Leste (5.8% vs. 2.3%).

The distribution of mothers with anaemia and children with overweight/obesity differed from that of mothers with overweight/obesity and children with anaemia; and differences in prevalence across groups was minimal, although with some exceptions (**Tables 6.7, 6.8** and **6.9**).

Figure 6.5 displays the distribution of mothers with anaemia and children with overweight/obesity by WHO regions and overall. Overall, the highest prevalence of mothers with anaemia and children with overweight/obesity was found in the poorest household wealth quintile (2.7%) and lowest maternal education level (2.4%); whereas the lowest prevalence was observed in the third and fourth household wealth quintile (2.5%) and the highest maternal education level (2.1%) (**Figure 6.5**). By area of residence, both urban and rural areas had an overall 2.7% prevalence of this form of intra-household DBM; although the prevalence was slightly higher among rural residents in the Eastern Mediterranean, European and Southeast Asian regions (**Figure 6.5)**. A distinct pattern was found in the Americas region by the three socioeconomic measures (i.e., highest prevalence in the third wealth quintile, highest maternal education level and in urban areas), and in the Southeast Asian region by household wealth and maternal education (**Figure 6.5**).

Table 6.7. Households with anaemia among mothers and overweight/obesity among children by household wealth.

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
			AFRICAN REGION				
Regional prevalence	**2.7 [2.1, 3.3]**	**2.7 [2.2, 3.3]**	**2.7 [2.1, 3.2]**	**2.5 [1.9, 3.1]**	**2.5 [2.0, 3.1]**	**-0.2**	**-**
Benin 2017-18	0.8 [0.3, 2.1]	1.0 [0.5, 2.1]	1.8 [1.0, 3.3]	0.8 [0.4, 1.7]	0.8 [0.4, 1.8]	0.0	0.2833
Burkina Faso 2010	3.1 [1.9, 5.0]	2.7 [1.7, 4.3]	2.4 [1.3, 4.4]	2.1 [1.2, 3.4]	1.8 [0.9, 3.5]	-1.3	0.6719
Burundi 2016-17	0.8 [0.3, 1.8]	1.1 [0.4, 2.7]	0.9 [0.4, 2.1]	1.0 [0.4, 2.2]	0.4 [0.1, 1.1]	-0.4	0.7927
Cameroon 2011	2.5 [1.4, 4.3]	4.1 [2.1, 7.6]	5.1 [3.4, 7.6]	3.7 [2.5, 5.7]	3.2 [1.9, 5.3]	0.7	0.3878
Congo 2011-12	1.6 [1.0, 2.5]	3.0 [1.6, 5.4]	2.7 [1.1, 6.7]	2.2 [0.9, 5.5]	3.2 [1.3, 7.3]	1.6	0.7636
Cote d'Ivoire 2011-12	2.4 [1.2, 4.8]	2.6 [1.3, 4.9]	2.6 [1.1, 5.6]	2.6 [1.3, 5.1]	3.8 [1.6, 9.1]	1.4	0.8896
DRC 2013-14	3.3 [2.1, 5.2]	2.8 [1.6, 5.0]	4.3 [2.8, 6.6]	3.2 [1.8, 5.8]	2.5 [1.4, 4.4]	-0.8	0.6197
Eswatini 2006-07	2.4 [1.2, 4.5]	5.7 [3.8, 8.5]	3.5 [2.1, 5.8]	5.3 [3.1, 9.0]	4.7 [3.1, 7.2]	2.3	0.3003
Ethiopia 2016	3.1 [1.4, 6.7]	0.5 [0.2, 1.5]	0.8 [0.4, 1.9]	0.6 [0.2, 1.8]	1.0 [0.5, 2.2]	-2.1	0.0014
Gabon 2012	6.9 [4.9, 9.6]	5.3 [3.0, 9.3]	7.7 [3.7, 15.4]	8.0 [4.0, 15.5]	7.2 [3.8, 13.0]	0.3	0.8803

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.7. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
Gambia 2013	3.4 [2.0, 5.9]	1.5 [0.7, 3.4]	4.8 [2.8, 7.9]	3.7 [1.2, 10.8]	2.8 [1.2, 6.4]	-0.6	0.4014
Ghana 2014	1.2 [0.5, 2.9]	2.0 [1.0, 4.0]	2.4 [1.0, 6.0]	0.6 [0.1, 2.5]	1.7 [0.6, 5.0]	0.5	0.4603
Guinea 2018	2.8 [1.6, 4.8]	2.2 [1.2, 4.0]	3.0 [1.4, 6.3]	2.3 [1.1, 4.7]	4.7 [2.8, 8.0]	1.9	0.4055
Lesotho 2014	2.3 [0.9, 5.5]	4.1 [2.0, 8.2]	3.6 [1.4, 9.0]	0.2 [0.0, 1.7]	0.8 [0.2, 2.8]	-1.5	0.0454
Malawi 2015-16	0.8 [0.4, 1.9]	2.1 [1.3, 3.5]	2.5 [1.5, 4.2]	2.1 [1.2, 3.7]	1.6 [0.7, 3.6]	0.8	0.2408
Mali 2018	1.2 [0.5, 3.1]	2.1 [1.0, 4.4]	1.3 [0.6, 2.9]	2.0 [1.0, 3.9]	1.4 [0.6, 3.4]	0.2	0.7836
Mozambique 2011	7.8 [6.0, 10.1]	7.5 [5.7, 9.8]	8.5 [6.3, 11.4]	8.2 [6.4, 10.3]	6.3 [4.8, 8.1]	-1.5	0.6382
Namibia 2013	0.9 [0.2, 3.4]	1.2 [0.4, 3.1]	0.1 [0.0, 0.4]	1.0 [0.4, 2.8]	0.0 [0.0, 0.0]	-0.9	0.2543
Niger 2012	2.5 [1.1, 5.4]	0.6 [0.2, 2.0]	1.7 [0.7, 4.2]	0.4 [0.1, 1.3]	2.4 [1.2, 5.0]	-0.1	0.0549
Nigeria 2018	1.7 [1.0, 3.1]	3.0 [2.1, 4.5]	2.2 [1.5, 3.4]	2.4 [1.4, 4.0]	1.0 [0.5, 2.1]	-0.7	0.0894
Rwanda 2014-15	3.3 [2.1, 5.2]	3.3 [2.0, 5.2]	1.5 [0.7, 3.5]	1.4 [0.6, 2.9]	1.1 [0.4, 2.7]	-2.2	0.0465

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.7. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AFRICAN REGION							
STP 2008-09	8.5 [4.7, 14.8]	8.0 [4.8, 13.1]	6.9 [3.1, 14.6]	6.9 [3.5, 13.4]	12.5 [7.2, 20.9]	4.0	0.5273
Senegal 2010-11	3.2 [2.1, 4.9]	1.8 [0.9, 3.4]	3.0 [1.6, 5.5]	3.8 [1.9, 7.4]	1.9 [0.6, 6.2]	-1.3	0.5086
Sierra Leone 2013	7.9 [5.8, 10.6]	5.9 [4.0, 8.7]	5.8 [3.9, 8.5]	6.4 [4.4, 9.2]	4.0 [2.4, 6.6]	-3.9	0.2793
South Africa 2016	7.1 [4.2, 11.8]	8.3 [3.9, 16.8]	3.6 [1.6, 7.9]	1.6 [0.5, 5.3]	4.7 [1.2, 16.1]	-2.4	0.1271
Tanzania 2015-16	2.5 [1.7, 3.5]	2.5 [1.5, 4.3]	2.5 [1.5, 4.3]	2.3 [1.5, 3.5]	2.4 [1.5, 3.8]	-0.1	0.9983
Togo 2013-14	0.7 [0.2, 1.9]	1.2 [0.4, 3.3]	1.9 [0.8, 4.2]	1.3 [0.4, 3.9]	2.1 [1.0, 4.3]	1.4	0.5098
Uganda 2016	2.1 [1.1, 3.8]	2.2 [1.2, 4.1]	1.8 [0.9, 3.6]	3.5 [2.0, 6.2]	1.2 [0.5, 3.3]	-0.9	0.2621
Zimbabwe 2015	0.9 [0.4, 2.1]	1.0 [0.5, 2.3]	0.6 [0.2, 1.4]	1.8 [1.0, 3.1]	2.2 [1.2, 3.8]	1.3	0.1016
EASTERN MEDITERRANEAN REGION							
Regional prevalence	**5.2 [3.8, 6.6]**	**3.3 [2.2, 4.4]**	**3.1 [2.1, 4.1]**	**4.2 [3.1, 5.4]**	**4.2 [3.0, 5.4]**	**-1.0**	**-**
Egypt 2014	6.5 [4.5, 9.1]	3.7 [2.4, 5.7]	3.6 [2.2, 6.0]	6.6 [4.3, 9.8]	9.2 [6.8, 12.3]	2.7	0.0046

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.7. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
EASTERN MEDITERRANEAN REGION							
Yemen 2013	5.0 [2.8, 8.7]	3.3 [1.6, 6.8]	4.1 [2.3, 7.2]	3.6 [2.2, 5.8]	1.6 [0.8, 3.3]	-3.4	0.2582
EUROPEAN REGION							
Regional prevalence	**5.1 [3.5, 6.7]**	**4.8 [3.1, 6.4]**	**3.8 [2.0, 5.6]**	**3.4 [2.2, 4.7]**	**4.5 [2.4, 6.6]**	**-0.6**	-
Albania 2017-18	5.2 [3.6, 7.7]	5.8 [3.2, 10.1]	6.2 [3.3, 11.5]	3.8 [2.0, 7.1]	4.5 [1.5, 12.2]	-0.7	0.8100
Armenia 2015-16	3.0 [1.3, 6.4]	2.3 [1.0, 5.3]	2.3 [0.8, 6.2]	2.2 [0.8, 5.7]	0.0 [0.0, 0.0]	-3.0	0.1914
Azerbaijan 2006	8.8 [7.0, 11.0]	10.6 [7.4, 15.0]	6.8 [4.7, 9.7]	5.3 [3.6, 7.9]	10.0 [6.5, 15.0]	1.2	0.3009
Kyrgyz Republic 2012	6.9 [4.2, 11.1]	5.9 [4.0, 8.7]	4.1 [2.8, 6.0]	6.1 [3.7, 9.9]	6.8 [4.1, 10.8]	-0.1	0.5883
Moldova 2005	5.4 [3.1, 9.3]	5.4 [2.9, 9.8]	2.5 [1.2, 5.1]	1.2 [0.6, 2.4]	4.7 [2.4, 9.2]	-0.7	0.1143
Tajikistan 2017	2.3 [1.3, 4.2]	2.8 [1.7, 4.7]	1.3 [0.7, 2.7]	2.8 [1.7, 4.6]	2.8 [1.7, 4.3]	0.5	0.4218

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.7. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
AMERICAS REGION							
Regional prevalence	**1.9 [1.1, 2.8]**	**1.3 [0.7, 2.0]**	**2.2 [0.6, 1.7]**	**1.9 [1.2, 2.6]**	**2.1 [1.2, 3.0]**	**0.2**	**-**
Bolivia 2008	8.3 [5.6, 12.2]	5.1 [3.1, 8.4]	2.7 [1.4, 5.3]	5.2 [3.0, 8.9]	4.5 [2.2, 8.8]	-3.8	0.0658
Guatemala 2014-15	1.5 [1.0, 2.3]	0.4 [0.2, 0.9]	0.6 [0.3, 1.2]	1.1 [0.7, 1.9]	0.9 [0.5, 1.8]	-0.6	0.0152
Guyana 2009	4.1 [1.9, 8.7]	4.4 [1.8, 10.5]	0.7 [0.2, 3.1]	4.1 [1.6, 9.9]	0.3 [0.0, 2.4]	-3.8	0.0348
Haiti 2016-17	1.8 [0.9, 3.6]	2.5 [1.4, 4.6]	2.1 [1.1, 3.9]	2.3 [1.2, 4.5]	2.8 [1.3, 5.7]	1.0	0.9076
Honduras 2011-12	0.3 [0.2, 0.6]	0.6 [0.3, 1.2]	0.6 [0.3, 1.4]	0.9 [0.5, 1.7]	2.1 [1.2, 3.5]	1.8	0.0003
Peru 2012	1.2 [0.8, 2.0]	0.8 [0.5, 1.4]	1.5 [0.8, 2.7]	2.2 [1.2, 3.9]	3.6 [2.1, 6.1]	2.4	0.0026
SOUTHEAST ASIAN REGION							
Regional prevalence	**1.6 [0.8, 2.4]**	**1.4 [0.7, 2.1]**	**2.2 [0.9, 3.6]**	**1.5 [0.4, 2.6]**	**1.9 [1.3, 2.6]**	**0.3**	**-**
India 2015-16	1.7 [1.6, 1.9]	1.6 [1.4, 1.8]	1.9 [1.7, 2.1]	2.0 [1.7, 2.2]	2.1 [1.9, 2.5]	0.4	0.0135

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.7. (continued)

	Household wealth quintiles*						
Country and survey year	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION							
Maldives 2016-17	2.8 [1.6, 4.7]	2.4 [1.4, 4.3]	4.2 [2.8, 6.3]	8.0 [4.0, 15.4]	0.0 [0.0, 0.0]	-2.8	0.0033
Myanmar 2015-16	0.4 [0.1, 1.0]	0.6 [0.2, 2.1]	0.3 [0.1, 1.8]	0.5 [0.1, 2.0]	1.9 [0.8, 4.4]	1.5	0.0526
Nepal 2016	0.6 [0.2, 2.2]	1.0 [0.4, 2.6]	0.0 [0.0, 0.0]	0.3 [0.0, 1.9]	0.0 [0.0, 0.0]	-0.6	0.3158
Timor-Leste 2016	1.5 [0.6, 3.7]	1.3 [0.4, 4.2]	3.0 [1.4, 6.4]	1.5 [0.5, 4.4]	4.3 [1.8, 9.6]	2.8	0.1910
WESTERN PACIFIC REGION							
Regional prevalence	-	-	-	-	-	-	-
Cambodia 2014	1.1 [0.5, 2.1]	1.2 [0.6, 2.5]	0.9 [0.3, 2.3]	1.8 [0.8, 3.8]	1.6 [0.7, 3.4]	0.5	0.7018
OVERALL POOLED PREVALENCE	**2.7 [2.3, 3.1]**	**2.5 [2.2, 2.9]**	**2.4 [2.1, 2.8]**	**2.4 [2.1, 2.8]**	**2.5 [2.1, 2.9]**	**-0.2**	-

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest household wealth quintile (Q5-Q1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by household wealth quintiles.

Table 6.8. Households with anaemia among mothers and overweight/obesity among children by maternal education level.

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AFRICAN REGION						
Regional prevalence	**2.9 [2.1, 3.6]**	**2.7 [2.1, 3.4]**	**2.7 [2.1, 3.4]**	**1.9 [1.3, 2.5]**	**-1.0**	**-**
Benin 2017-18	1.1 [0.7, 1.6]	1.1 [0.5, 2.2]	1.1 [0.5, 2.4]	1.2 [0.2, 9.1]	0.1	0.9989
Burkina Faso 2010¶	2.5 [1.9, 3.3]	1.7 [0.8, 3.6]	2.5 [0.9, 6.5]	-	-	-
Burundi 2016-17	0.7 [0.4, 1.3]	1.1 [0.6, 1.9]	0.8 [0.2, 2.6]	0.0 [0.0, 0.0]	-0.7	0.7123
Cameroon 2011	2.1 [1.2, 3.5]	4.1 [3.0, 5.6]	4.8 [3.5, 6.5]	1.5 [0.3, 6.3]	-0.6	0.0511
Congo 2011-12	3.2 [0.8, 12.6]	2.1 [1.3, 3.6]	2.6 [1.6, 4.2]	2.6 [0.5, 13.2]	-0.6	0.9226
Cote d'Ivoire 2011-12¶	3.3 [2.2, 4.9]	1.8 [0.9, 3.7]	1.4 [0.2, 8.3]	-	-	-
DRC 2013-14	3.0 [1.8, 5.1]	2.8 [1.9, 4.0]	4.0 [2.6, 6.0]	1.4 [0.2, 10.1]	-1.6	0.3929
Eswatini 2006-07	5.1 [2.8, 9.1]	3.3 [2.0, 5.5]	4.4 [3.0, 6.2]	8.2 [4.7, 14.1]	3.1	0.2439
Ethiopia 2016	1.0 [0.5, 1.8]	1.5 [0.8, 2.8]	2.8 [1.2, 6.4]	1.0 [0.3, 3.9]	0.0	0.0875
Gabon 2012	9.3 [3.2, 24.1]	7.5 [5.0, 10.9]	6.9 [4.7, 9.9]	4.9 [0.9, 21.7]	-4.4	0.8413

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.8. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AFRICAN REGION						
Gambia 2013	2.9 [1.9, 4.4]	3.1 [1.5, 6.6]	3.7 [1.9, 7.2]	3.8 [1.2, 11.9]	0.9	0.8620
Ghana 2014	1.9 [0.9, 4.0]	1.6 [0.7, 3.9]	1.3 [0.6, 2.7]	2.7 [0.3, 19.0]	0.8	0.8130
Guinea 2018	2.7 [1.9, 3.8]	2.4 [0.8, 6.7]	4.9 [2.6, 9.0]	2.8 [0.3, 19.3]	0.1	0.4635
Lesotho 2014¶	-	2.6 [1.4, 4.6]	2.3 [1.1, 4.9]	1.1 [0.3, 4.4]	-	-
Malawi 2015-16	2.7 [1.4, 5.4]	1.7 [1.2, 2.4]	1.8 [1.0, 3.2]	0.4 [0.1, 1.0]	-2.3	0.3136
Mali 2018	1.5 [1.0, 2.4]	2.5 [1.1, 5.6]	1.5 [0.6, 3.7]	0.0 [0.0, 0.0]	-1.5	0.6396
Mozambique 2011	8.4 [7.0, 10.1]	7.5 [6.4, 8.8]	6.5 [4.7, 8.9]	1.6 [0.2, 11.6]	-6.8	0.1887
Namibia 2013	0.0 [0.0, 0.0]	1.7 [0.7, 4.0]	0.5 [0.2, 1.2]	0.0 [0.0, 0.0]	0.0	0.2019
Niger 2012¶	1.6 [1.0, 2.5]	0.5 [0.2, 1.4]	0.9 [0.2, 2.9]	-	-	-
Nigeria 2018	2.3 [1.7, 3.2]	2.3 [1.4, 3.8]	1.9 [1.4, 2.7]	1.2 [0.5, 2.9]	-1.1	0.4841
Rwanda 2014-15	3.2 [1.7, 6.0]	2.0 [1.4, 2.8]	2.6 [1.2, 5.6]	0.0 [0.0, 0.0]	-3.2	0.4029

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.8. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AFRICAN REGION						
STP 2008-09¶	18.1 [7.1, 38.8]	7.0 [5.0, 9.8]	10.0 [5.8, 16.7]	-	-	-
Senegal 2010-11¶	3.2 [2.2, 4.6]	1.7 [0.8, 3.8]	2.4 [0.4, 12.4]	-	-	-
Sierra Leone 2013	6.7 [5.5, 8.1]	3.5 [2.0, 5.9]	6.0 [3.9, 9.0]	4.6 [0.8, 23.1]	-2.1	0.1827
South Africa 2016¶	-	6.8 [3.1, 14.3]	5.8 [3.7, 8.7]	0.7 [0.1, 5.4]	-	-
Tanzania 2015-16	2.6 [1.4, 4.9]	2.3 [1.8, 3.0]	2.8 [1.7, 4.4]	1.3 [0.3, 5.7]	-1.3	0.8024
Togo 2013-14¶	0.7 [0.3, 1.7]	1.1 [0.5, 2.1]	2.9 [1.5, 5.5]	-	-	-
Uganda 2016	1.8 [0.7, 4.6]	2.0 [1.4, 3.0]	2.5 [1.3, 4.9]	2.2 [0.8, 6.2]	0.4	0.9065
Zimbabwe 2015	1.6 [0.2, 12.5]	1.3 [0.7, 2.3]	1.1 [0.7, 1.5]	3.9 [1.5, 9.7]	2.3	0.0279
EASTERN MEDITERRANEAN REGION						
Regional prevalence	**-**	**-**	**-**	**-**	**-**	**-**
Egypt 2014	5.4 [3.5, 8.2]	7.2 [4.2, 12.0]	5.3 [4.2, 6.7]	6.6 [4.3, 10.1]	1.2	0.6411

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.8. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
EASTERN MEDITERRANEAN REGION						
Yemen 2013§	-	-	-	-	-	-
EUROPEAN REGION						
Regional prevalence	-	-	-	-	-	-
Albania 2017-18¶	-	7.3 [5.2, 10.1]	2.2 [1.1, 4.5]	3.9 [1.8, 8.1]	-	-
Armenia 2015-16¶	-	1.9 [0.2, 13.3]	2.4 [1.4, 4.3]	1.5 [0.7, 3.1]	-	-
Azerbaijan 2006¶	-	-	9.1 [7.6, 10.9]	4.4 [3.6, 5.4]	-	-
Kyrgyz Republic 2012¶	-	-	6.6 [5.0, 8.6]	5.1 [3.6, 7.1]	-	-
Moldova 2005¶	-	-	3.9 [2.7, 5.6]	3.8 [2.4, 6.0]	-	-
Tajikistan 2017	1.0 [0.1, 7.2]	2.3 [0.8, 6.1]	2.5 [1.9, 3.3]	1.9 [1.1, 3.4]	0.9	0.6642

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.8. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
AMERICAS REGION						
Regional prevalence	**1.5 [0.8, 2.2]**	**1.7 [1.0, 2.5]**	**1.7 [1.1, 2.3]**	**2.2 [1.6, 2.8]**	**0.7**	**-**
Bolivia 2008	7.0 [2.5, 17.8]	6.6 [4.9, 8.9]	4.0 [2.5, 6.5]	2.6 [1.2, 5.5]	-4.4	0.0659
Guatemala 2014-15	1.0 [0.6, 1.7]	1.0 [0.7, 1.5]	0.6 [0.4, 1.1]	1.8 [0.7, 4.1]	0.8	0.2345
Guyana 2009	3.8 [0.4, 27.6]	1.7 [0.5, 6.0]	3.1 [1.6, 5.8]	2.1 [0.3, 14.2]	-1.7	0.8108
Haiti 2016-17	2.9 [1.5, 5.6]	1.9 [1.2, 3.1]	2.4 [1.5, 3.8]	2.0 [0.6, 6.3]	-0.9	0.7323
Honduras 2011-12	1.1 [0.3, 3.9]	0.5 [0.3, 0.8]	0.9 [0.6, 1.6]	3.3 [1.5, 7.1]	2.2	0.0001
Peru 2012	0.8 [0.2, 3.8]	1.2 [0.8, 1.9]	1.3 [0.8, 2.0]	3.1 [2.1, 4.7]	2.3	0.0010
SOUTHEAST ASIAN REGION						
Regional prevalence	**1.6 [0.3, 2.8]**	**1.3 [0.4, 2.2]**	**1.8 [0.9, 2.6]**	**2.0 [1.2, 2.8]**	**0.4**	**-**
India 2015-16	1.8 [1.7, 2.0]	1.7 [1.5, 2.0]	1.8 [1.7, 2.0]	2.1 [1.8, 2.6]	0.3	0.1959

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.8. (continued)

	Maternal education level*					
Country and survey year	**None (E1)**	**Primary (E2)**	**Secondary (E3)**	**Higher (E4)**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION						
Maldives 2016-17	2.8 [0.3, 21.9]	3.0 [1.8, 5.0]	3.7 [2.5, 5.7]	3.5 [1.6, 7.2]	0.7	0.9100
Myanmar 2015-16	0.1 [0.0, 0.7]	0.6 [0.2, 1.3]	0.7 [0.3, 1.7]	1.9 [0.6, 6.1]	1.8	0.0750
Nepal 2016	0.0 [0.0, 0.0]	0.4 [0.0, 2.7]	0.5 [0.2, 1.4]	1.1 [0.4, 3.4]	1.1	0.1324
Timor-Leste 2016	2.2 [1.0, 4.7]	1.1 [0.3, 4.1]	2.5 [1.3, 4.8]	4.2 [1.2, 13.5]	2.0	0.4564
WESTERN PACIFIC REGION						
Regional prevalence	-	-	-	-	-	-
Cambodia 2014	1.0 [0.4, 2.6]	1.2 [0.7, 1.9]	1.5 [0.8, 2.7]	2.5 [0.3, 16.3]	1.5	0.7379
OVERALL POOLED PREVALENCE	**2.4 [2.0, 2.9]**	**2.3 [1.9, 2.7]**	**2.3 [2.0, 2.7]**	**2.1 [1.8, 2.4]**	**-0.3**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between the highest and lowest education level (E4-E1).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by education level.
§ Yemen has missing data on education level, and thus, the stratified estimates could not be calculated.
¶ Estimates for certain categories are missing due to sample size <25.

Table 6.9. Households with anaemia among mothers and overweight/obesity among children by area of residence.

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Regional prevalence	**2.8 [2.2, 3.3]**	**2.8 [2.3, 3.3]**	**0.0**	**-**
Benin 2017-18	0.9 [0.5, 1.5]	1.2 [0.8, 1.8]	-0.3	0.3085
Burkina Faso 2010	2.4 [1.4, 4.1]	2.5 [1.8, 3.3]	-0.1	0.9119
Burundi 2016-17	0.3 [0.1, 1.4]	0.9 [0.6, 1.4]	-0.6	0.1317
Cameroon 2011	3.6 [2.7, 4.8]	3.8 [2.8, 5.3]	-0.2	0.7448
Congo 2011-12	2.9 [1.8, 4.6]	1.9 [1.3, 2.6]	1.0	0.1306
Cote d'Ivoire 2011-12	2.8 [1.4, 5.6]	2.6 [1.8, 3.9]	0.2	0.8428
DRC 2013-14	2.2 [1.4, 3.4]	3.7 [2.8, 5.0]	-1.5	0.0401
Eswatini 2006-07	6.7 [4.3, 10.4]	3.8 [2.7, 5.2]	2.9	0.0347
Ethiopia 2016	1.4 [0.7, 3.0]	1.2 [0.7, 2.1]	0.2	0.7169
Gabon 2012	7.0 [5.0, 9.9]	7.2 [5.0, 10.1]	-0.2	0.9353

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 6.9. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
Gambia 2013	3.0 [1.5, 5.9]	3.3 [2.2, 5.0]	-0.3	0.8357
Ghana 2014	1.6 [0.8, 3.1]	1.6 [0.9, 2.7]	0.0	0.9597
Guinea 2018	3.3 [2.1, 5.4]	2.8 [2.0, 3.8]	0.5	0.5124
Lesotho 2014	1.7 [0.4, 6.8]	2.5 [1.6, 4.0]	-0.8	0.5877
Malawi 2015-16	1.2 [0.4, 3.3]	1.9 [1.4, 2.5]	-0.7	0.3981
Mali 2018	1.7 [0.8, 3.4]	1.6 [1.1, 2.5]	0.1	0.9006
Mozambique 2011	6.8 [5.3, 8.5]	8.0 [7.0, 9.2]	-1.2	0.2122
Namibia 2013	0.4 [0.1, 1.3]	0.9 [0.4, 1.9]	-0.5	0.2114
Niger 2012	3.1 [1.5, 6.2]	1.2 [0.7, 2.0]	1.9	0.0226
Nigeria 2018	1.7 [1.2, 2.6]	2.4 [1.8, 3.1]	-0.7	0.1992
Rwanda 2014-15	1.3 [0.6, 2.9]	2.4 [1.8, 3.3]	-1.1	0.1484

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 6.9. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AFRICAN REGION				
STP 2008-09	8.9 [5.7, 13.8]	7.9 [5.4, 11.5]	1.0	0.6938
Senegal 2010-11	2.8 [1.5, 5.1]	2.8 [1.9, 3.9]	0.0	0.9920
Sierra Leone 2013	5.0 [3.6, 6.9]	6.5 [5.3, 7.9]	-1.5	0.1702
South Africa 2016	4.8 [2.6, 8.8]	5.9 [3.9, 8.9]	-1.1	0.5876
Tanzania 2015-16	2.2 [1.4, 3.3]	2.5 [1.9, 3.3]	-0.3	0.5675
Togo 2013-14	1.8 [0.9, 3.5]	1.2 [0.6, 2.1]	0.6	0.3263
Uganda 2016	2.0 [1.0, 4.0]	2.2 [1.6, 3.0]	-0.2	0.8191
Zimbabwe 2015	2.1 [1.4, 3.3]	0.9 [0.6, 1.4]	1.2	0.0067
EASTERN MEDITERRANEAN REGION				
Regional prevalence	**3.9 [3.0, 4.8]**	**4.1 [3.4, 4.7]**	**-0.2**	**-**
Egypt 2014	7.5 [5.8, 9.7]	4.8 [3.7, 6.2]	2.7	0.0143

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 6.9. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
EASTERN MEDITERRANEAN REGION				
Yemen 2013	1.8 [1.0, 3.4]	4.3 [3.0, 6.1]	-2.5	0.0170
EUROPEAN REGION				
Regional prevalence	**4.2 [2.6, 5.9]**	**4.5 [3.0, 6.0]**	**-0.3**	**-**
Albania 2017-18	5.6 [3.5, 8.9]	4.6 [3.3, 6.4]	1.0	0.4877
Armenia 2015-16	1.4 [0.7, 2.8]	2.6 [1.5, 4.4]	-1.2	0.1689
Azerbaijan 2006	8.2 [6.0, 11.1]	8.6 [6.7, 10.9]	-0.4	0.8251
Kyrgyz Republic 2012	6.2 [4.1, 9.3]	5.7 [4.5, 7.2]	0.5	0.7233
Moldova 2005	3.1 [1.8, 5.4]	4.3 [2.8, 6.6]	-1.2	0.3590
Tajikistan 2017	2.9 [2.0, 4.3]	2.2 [1.7, 3.0]	0.7	0.2907

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 6.9. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
AMERICAS REGION				
Regional prevalence	**1.9 [1.3, 2.5]**	**1.8 [1.1, 2.5]**	**0.1**	**-**
Bolivia 2008	4.2 [2.9, 5.9]	6.7 [4.9, 9.1]	-2.5	0.0433
Guatemala 2014-15	0.9 [0.6, 1.4]	0.9 [0.7, 1.3]	0.0	0.9157
Guyana 2009	3.3 [1.4, 7.6]	2.6 [1.3, 5.0]	0.7	0.6609
Haiti 2016-17	2.7 [1.7, 4.2]	2.1 [1.4, 3.1]	0.6	0.4195
Honduras 2011-12	1.3 [0.9, 1.9]	0.5 [0.3, 0.7]	0.8	0.0005
Peru 2012	1.9 [1.4, 2.6]	1.4 [1.0, 2.1]	0.5	0.2281
SOUTHEAST ASIAN REGION				
Regional prevalence	**1.6 [0.6, 2.5]**	**1.7 [0.8, 2.7]**	**-0.1**	**-**
India 2015-16	2.1 [1.8, 2.3]	1.8 [1.7, 1.9]	0.3	0.0234

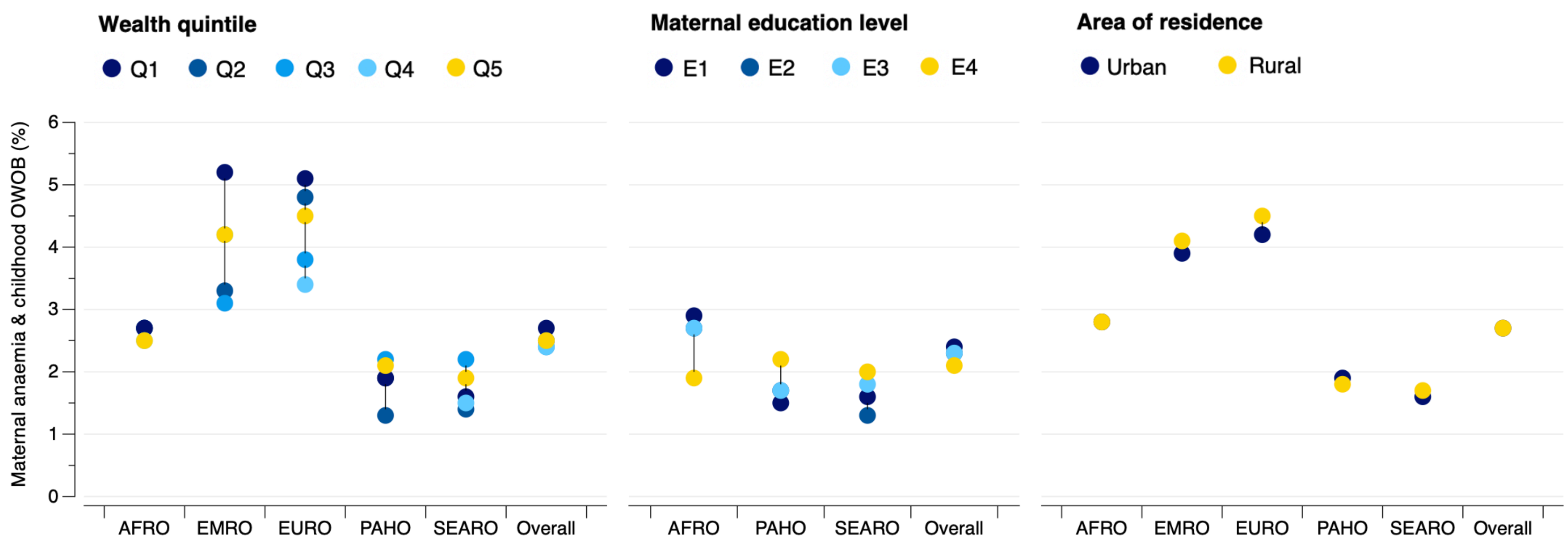
DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Table 6.9. (continued)

	Area of residence*			
Country and survey year	**Urban**	**Rural**	**Gap†**	**p-value‡**
SOUTHEAST ASIAN REGION				
Maldives 2016-17	3.3 [1.3, 8.3]	3.6 [2.8, 4.6]	-0.3	0.8730
Myanmar 2015-16	1.6 [0.8, 3.2]	0.4 [0.2, 0.8]	1.2	0.0031
Nepal 2016	0.3 [0.1, 0.9]	0.5 [0.2, 1.2]	-0.2	0.4745
Timor-Leste 2016	3.0 [1.3, 6.9]	2.0 [1.3, 3.3]	1.0	0.4237
WESTERN PACIFIC REGION				
Regional prevalence	**-**	**-**	**-**	**-**
Cambodia 2014	1.8 [0.8, 3.8]	1.2 [0.8, 1.8]	0.6	0.3737
OVERALL POOLED PREVALENCE	**2.7 [2.3, 3.0]**	**2.7 [2.4, 3.1]**	**0.0**	**-**

DRC, Democratic Republic of the Congo; STP, Sao Tome and Principe.
*Values are percentages and 95% CIs; estimates account for survey design. Regional estimates are pooled prevalences and 95% CIs, calculated with the available data from countries within that region. The Western Pacific region only had one country with available data (Cambodia), thus the regional prevalence was not calculated.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural).
‡ p-values <0.05 indicate significant differences in the distribution of concurrent overweight/obesity and anaemia by area of residence.

Figure 6.5. Distribution of the intra-household DBM (mothers with anaemia and children with overweight/obesity) by household wealth quintile, maternal education level and area of residence across WHO regions and overall.



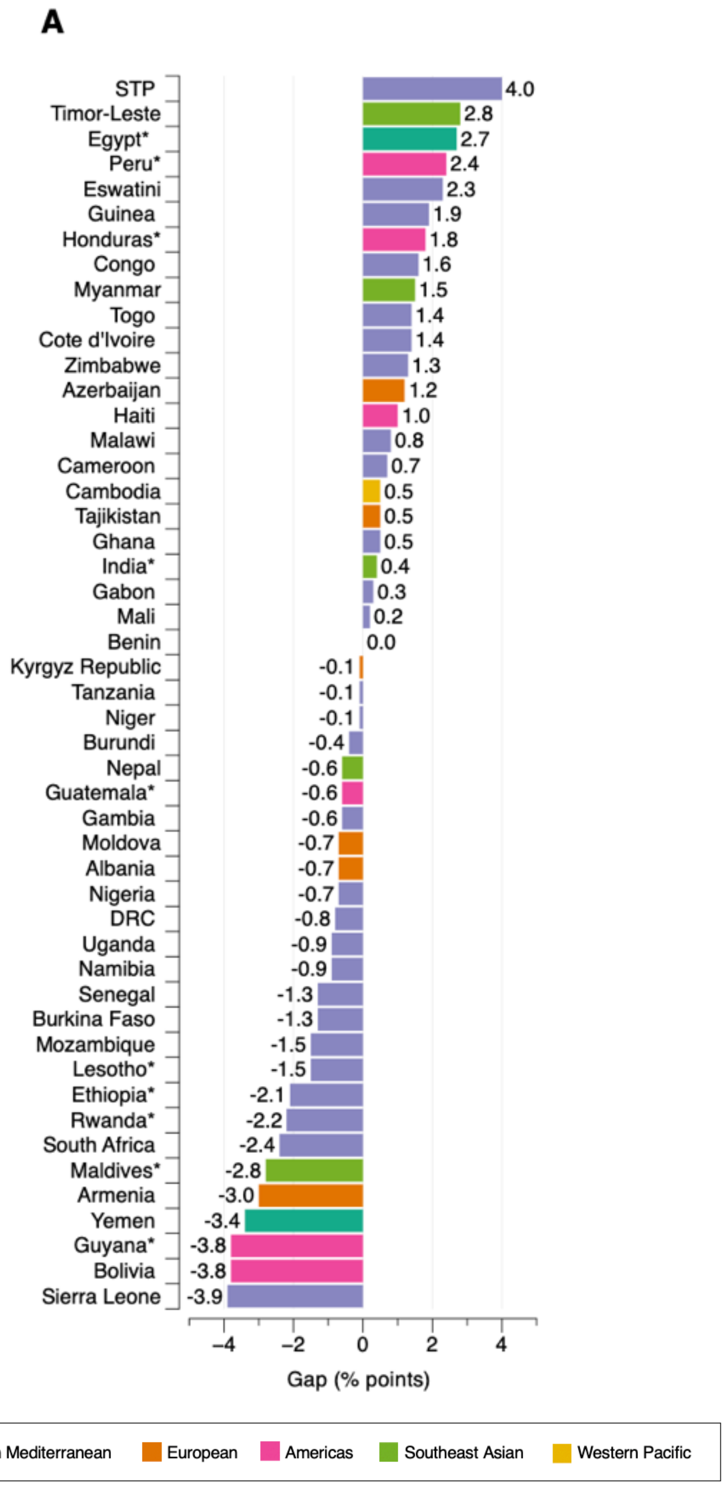
Note: OWOB: overweight/obesity; AFRO: African region; EMRO: Eastern Mediterranean region; EURO: European region; PAHO: Americas region; SEARO: Southeast Asian region. Wealth quintiles: Q1 (poorest), Q2 (poorer), Q3 (middle), Q4 (richer), Q5 (richest). Maternal education levels: E1 (no education); E2 (primary education); E3 (secondary education), E4 (higher education). The EMRO and EURO regions are missing for maternal education level, as 1/2 and 5/6 countries, respectively, had sample sizes below 25 observations for one or two education levels; and thus, the regional pooled prevalence could not be calculated. All countries with sample sizes above 25 observations for the five wealth quintiles, four maternal education levels and urban/rural areas were included in the calculation of the overall pooled prevalence estimates.

The widths of inequality gaps were largely less pronounced than those for mothers with overweight/obesity and children with anaemia, with only 11 instances where gaps in the prevalence of mothers with anaemia and children with overweight/obesity were equal or greater than 3.0 pp (**Figure 6.6 A**, **B** and **C**). The largest gaps were found in Sao Tome and Principe, with a 4.0 pp difference (p=0.527) in intra-household DBM by household wealth (Q1, 8.5%; Q5, 12.5%); Mozambique, with a -6.8 pp difference (p=0.189) by maternal education level (E1, 8.4%; E4, 1.6%); and Eswatini, with a 2.9 pp difference (p=0.035) by area of residence (Urban, 6.7%; Rural, 3.8%).

Gaps were positive in 44.9% (22/49) of countries by household wealth and area of residence, and in 51.4% (18/35) of countries by maternal education level (**Figure 6.6**); whilst gaps were negative in 53.1% (26/49), 42.9% (15/35), 45.0% (24/49) of countries by household wealth, maternal education level and area of residence, respectively. In six instances, the inequality gap in the prevalence of intra-household DBM was 0.0 pp, meaning that the prevalence of mothers with anaemia and children with overweight/obesity was the same in the richest and poorest wealth quintiles in Benin (0.8%); the most and least educated in Namibia (0.0%) and Ethiopia (1.0%); and among urban and rural residents in Guatemala (0.9%), Senegal (2.8%) and Ghana (1.6%) (**Figure 6.6 A**, **B** and **C**).

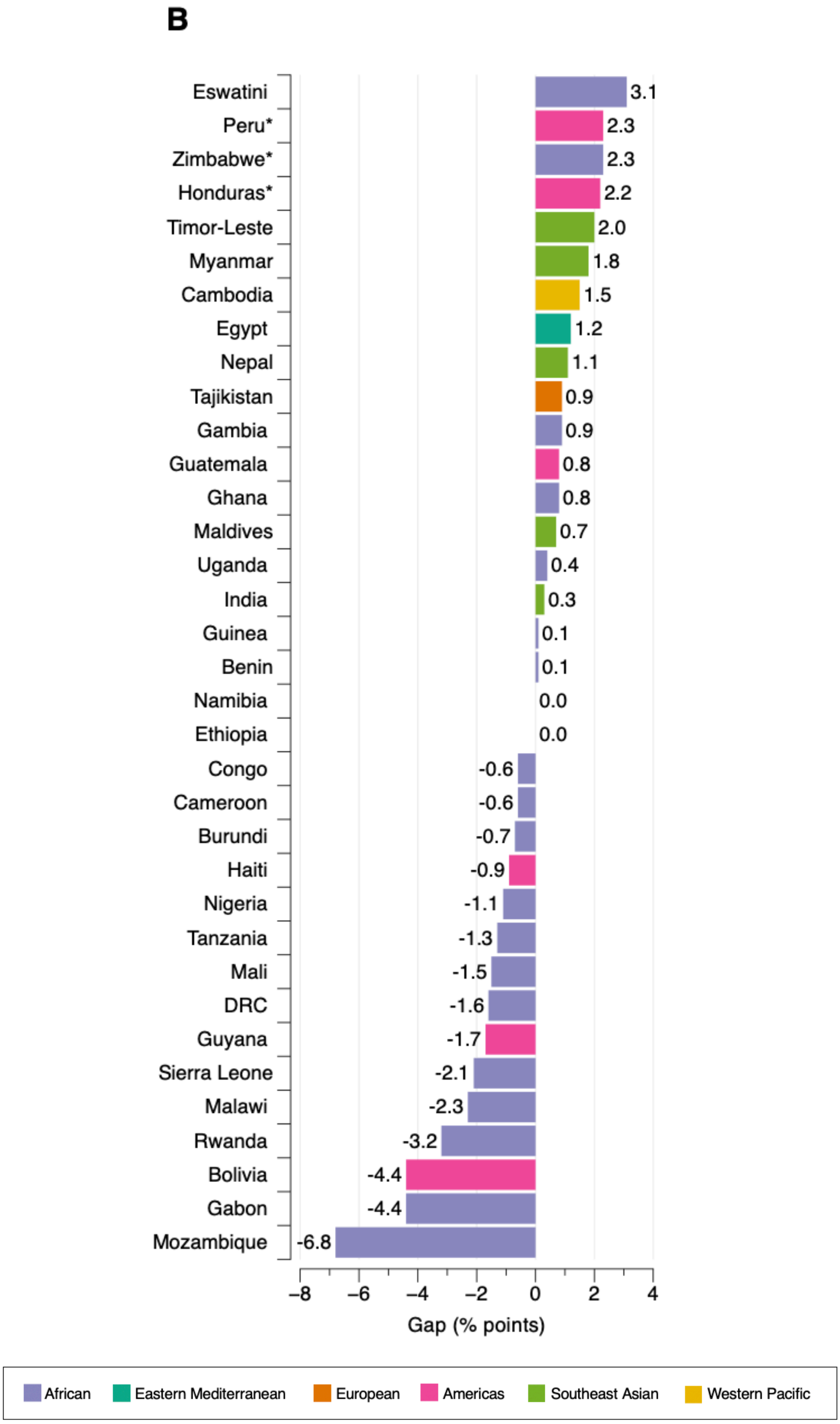
Differences in the prevalence of mothers with anaemia and children with overweight/obesity observed across groups were statistically significant in 10/49, 3/35 and 10/49 of countries by household wealth, maternal education level and area of residence, respectively (**Figure 6.6** and **Tables 6.7, 6.8** and **6.9**).

Figure 6.6. Absolute gap difference of households with anaemia among mothers and overweight/obesity among children by wealth quintile (A), maternal education level (B) and area of residence (C).



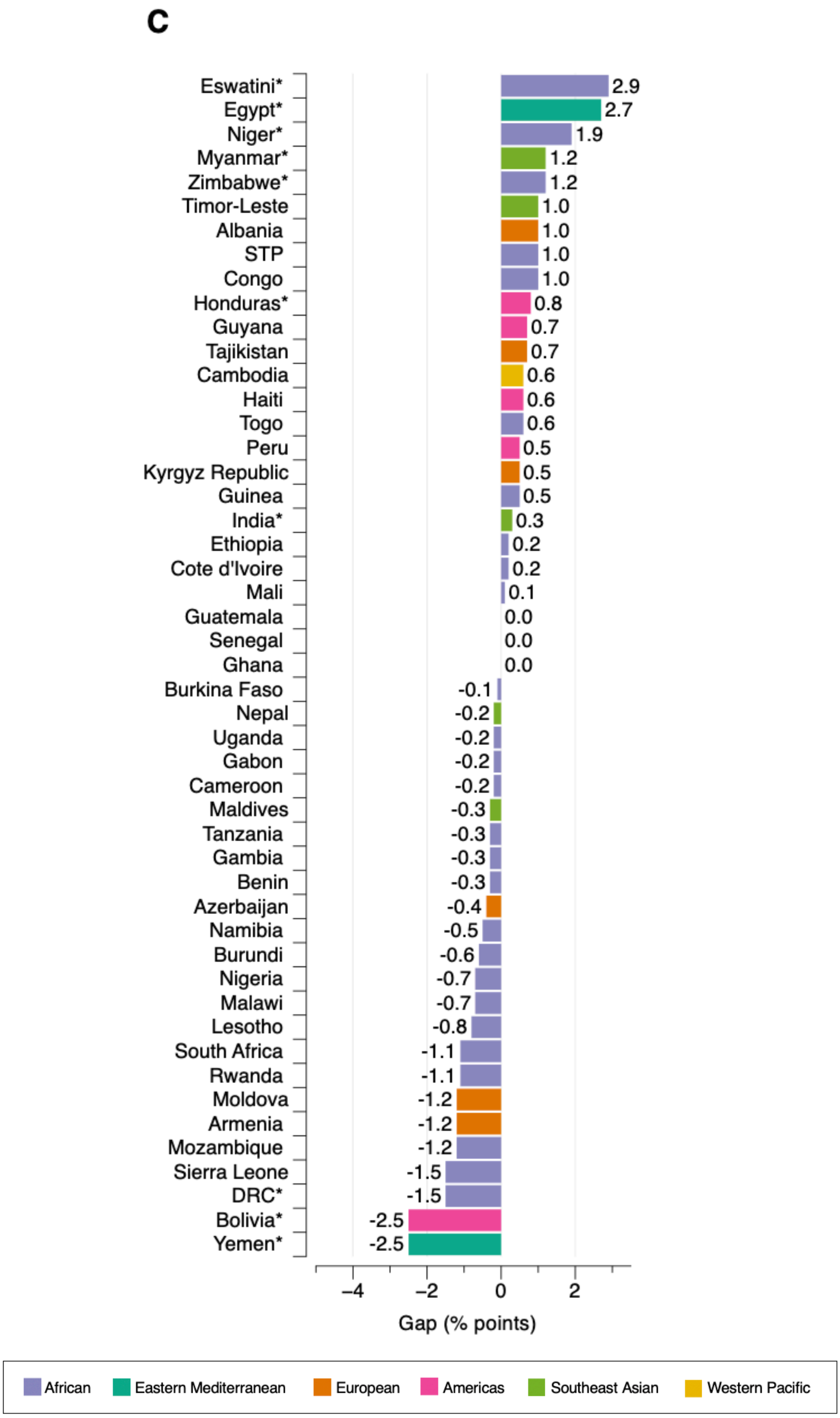
Note: Positive values mean that intra-household DBM is more prevalent in the richest quintile (Q5), highest maternal education level (E4) and in urban areas when compared to the poorest quintile (Q1), lowest maternal education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. Note that in figure B, countries with a sample size <25 observations for E1 or E4 were excluded. STP: Sao Tome and Principe; DRC: Democratic Republic of the Congo.

Figure 6.6. (continued)



Note: Positive values mean that intra-household DBM is more prevalent in the richest quintile (Q5), highest maternal education level (E4) and in urban areas when compared to the poorest quintile (Q1), lowest maternal education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. Note that in figure B, countries with a sample size <25 observations for E1 or E4 were excluded. STP: Sao Tome and Principe; DRC: Democratic Republic of the Congo.

Figure 6.6. (continued)



Note: Positive values mean that intra-household DBM is more prevalent in the richest quintile (Q5), highest maternal education level (E4) and in urban areas when compared to the poorest quintile (Q1), lowest maternal education level (E1) and rural areas. Negative values mean the opposite. (*) p-value <0.05. Note that in figure B, countries with a sample size <25 observations for E1 or E4 were excluded. STP: Sao Tome and Principe; DRC: Democratic Republic of the Congo.

6.3. Discussion

This study presents the magnitude, distribution, and inequalities of the co-occurrence of overweight/obesity and anaemia at the household level using nationally representative DHS samples across 49 LMICs from 2005 to 2018. These results show that almost 2 in 10 households presented a form of intra-household DBM, with South Africa bearing the highest burden (38.7%). Households with overweight/obesity among mothers and anaemia among children was the leading form of intra-household DBM (16.2%), when compared to households with anaemia among mothers and overweight/obesity among children (2.8%). Important variations in the prevalence of DBM were observed across and within countries, particularly for mothers with overweight/obesity and children with anaemia.

To the best of the PhD candidate's knowledge, no previous studies have comprehensively explored the prevalence of overweight/obesity and anaemia among mothers and their children under-5 at the household level across LMICs, as well as its distribution and inequalities by socioeconomic measures (i.e., household wealth, education level and area of residence). A systematic review quantifying the frequency of the different DBM operational definitions, only found one article published before July 2017 examining the co-occurrence of overweight/obesity and anaemia at the household level (Davis et al., 2020). Sassi et al. (2019) estimated the magnitude of mothers with overweight and children with anaemia living in Tunisia to be 24.4%, which is similar to the pooled prevalence obtained in this study for households with overweight/obesity among mothers and anaemia among children for the Eastern Mediterranean region (24.1%). Christian & Dake (2021), examined the household-level double and triple burden of malnutrition in Sub-Saharan African countries. The study enclosed in this chapter used different definitions of intra-household DBM, and therefore, the estimates presented here and those of Christian & Dake (2021) are not directly comparable.

The findings complement The Lancet Series on the DBM that quantified the co-existence of overweight/obesity and stunting, wasting or thinness at the household level. Popkin et al. (2020) found the combination women with overweight and children with stunting to be the most prevalent of all three possible scenarios (i.e., mothers with overweight and children with stunting; mothers with overweight and children with wasting; and mothers with thinness and children with overweight), ranging from 1.1% in Vietnam to 24.3% in Guatemala. Similarly, the highest prevalence of intra-household DBM in the present study was found in the combination with overweight/obesity among mothers and the form of undernutrition (i.e., anaemia) among children, ranging from 3.1% in Ethiopia to 42.2% in South Africa. This is not surprising as overweight/obesity remains low among children under-5, while it is rising rapidly among WRA in most LMICs (Development Initiatives, 2020). A hypothesis that has been put forward for this co-existence is poor quality diets characterised by the increased availability and consumption of ultra-processed foods in LMICs, which are energy-dense, but poor in vitamins and minerals, associated with excess weight and, possibly anaemia (Monteiro et al., 2011; Monteiro et al., 2013; Chen et al., 2020; Pagliai et al., 2021). Another plausible explanation for a high co-existence of intra-household DBM could be that maternal overweight/obesity increases the risk of childhood anaemia. Multiple studies suggest that obesity during pregnancy can impair both, maternal and neonatal iron status (Phillips et al., 2014; Jones et al., 2016b; Wawer et al., 2021). Moreover, maternal obesity increases the risk of fetal macrosomia, which in turn, may lead to inflammation, a rise in hepcidin levels, and over time, result in anaemia of inflammation (Ovesen et al., 2011; Wawer et al., 2021).

The co-occurrence of overweight/obesity and anaemia at the household level was unequally distributed, particularly the form with overweight/obesity among mothers and anaemia among children, by household wealth, maternal education level, and area of residence. The latter followed an inverse social gradient, emulating the distribution of maternal overweight/obesity, and maternal concurrent overweight/obesity and anaemia in LMICs, with overall higher estimates in the richest quintile, highest maternal education level and urban areas (Hossain et al., 2020; Jiwani et al., 2019; Jiwani et al., 2020; Matos et al., 2020; Irache et al., 2021). The different distribution patterns observed in the European and the Americas region for mothers with overweight/obesity and children with anaemia could be a reflection of changing trends documented in the prevalence of overweight/obesity towards the poorest groups and those living in rural areas (Monteiro, et al., 2004; Jiwani et al., 2019; NCD-RisC, 2019). If this was true, similar changes in patterns could be expected in the distribution of the intra-household DBM in the other regions as countries go through the different stages of the nutrition transition. Moreover, the analyses of absolute inequality for mothers with overweight/obesity and children with anaemia, conducted for the present study, showed large gaps by the three socioeconomic measures for most African countries and in Yemen by household wealth. In one quarter of all LMICs included in the analysis, the inequality gap in DBM was higher than 20.0 pp between the richest and poorest households. For example, in Togo, where the gap was highest (29.3 pp), the prevalence of mothers with overweight/obesity and children with anaemia ranged from 7.1% in the first wealth quintile to 36.4% in the fifth quintile. Nevertheless, inequalities were low in South Africa, where the prevalence of this form of intra-household DBM was the highest (42.2%), showing estimates > 36.0% for all household wealth quintiles, maternal education levels, and in urban and rural areas. This points to the need for context-specific interventions that responds to the specific nutritional needs of sub-populations within individual LMICs.

Negligible differences were observed in the prevalence of mothers with anaemia and children with overweight/obesity by the different sociodemographic measures, which is likely a result of lower proportions of overweight/obesity among children under-5, even though maternal anaemia is prevalent in LMICs. The overall inequality gap in this form of DBM was below 0.5 pp by household wealth (Q1: 2.7%; Q5: 2.6%), maternal education (E1: 2.5% vs E4: 2.2%) and place of residence (urban: 2.7% vs rural: 2.8%).

The present study is not without limitations. First, anaemia was used given that DHS surveys do not collect individual micronutrient deficiencies for the majority of LMICs. The proportion of anaemia among WRA and children attributed to iron deficiency is approximately 71.0% and 50.0% in countries with a low infection burden, respectively (Engle-Stone et al., 2017; Wirth et al., 2017). This proportion drops to 35.1% among women and remains at 58.0% among children under-5 in countries with a high infection burden (Engle-Stone et al., 2017; Wirth et al., 2017). Second, evidence has shown substantial differences in the estimation of anaemia depending on the method used to measure haemoglobin levels (Hruschka et al., 2020). DHS follows similar standardised procedures to collect haemoglobin levels through capillary blood across countries. Differences between the estimates enclosed in this chapter and those of similar studies using other data sources could be explained by the method used for haemoglobin assessment. Other factors that can lead to variability in the prevalence of anaemia include environmental factors, HemoCue® model, or seasonality (Hruschka et al., 2020). Third, the most recent DHS from all countries with available anthropometry and anaemia status among mothers and their children were included to the analysis; however, most countries were from the African region (n=29). Other WHO regions are likely to be underrepresented (i.e., the Eastern Mediterranean region (n=2) or the Western Pacific (n=1)), which limits the generalisability of our results. Fourth, the sample size for the different subgroups in the stratified analyses by maternal education level were lower than 25 observations in 13 out of the 49 LMICs included. Therefore, the inequality gap for those countries could not be calculated, as well as the pooled regional estimate for the European region. Likewise, the pooled estimate for the Eastern Mediterranean region could not be generated, as Yemen did not have data on maternal education level. Fifth, the most recent DHS surveys available for each country were used; however, these ranged from 2005 (Moldova) to 2018 (Guinea, Mali, and Nigeria). Therefore, country-level estimates from older surveys might not reflect the current intra-household DBM magnitude. Despite these limitations, this study has several strengths. To the best of the PhD candidate's knowledge, this is the largest study providing estimates on the intra-household double burden of overweight/obesity and anaemia across LMICs (n=49) and WHO regions, as well as exploring the distribution and inequalities by three socioeconomic measures. Moreover, overall large sample sizes from nationally representative surveys were analysed.

The study findings may support a better understanding on the intra-household double burden of overweight/obesity and anaemia. Historically, national nutrition policies of LMICs have mainly focused on childhood undernutrition, while ignoring the rapidly rising problem of overweight/obesity in these countries. This siloed approach has resulted in harmful unintended consequences. For example, a nutrition programme implemented in Guatemala that provided fortified food supplements in the first 1,000 days to mothers and children, successfully reduced childhood stunting, but also led to greater maternal weight retention (Leroy et al., 2019). Hawkes et al. (2020) have proposed a list of ten double-duty actions, which aim to simultaneously tackle both undernutrition and overweight/obesity, including the promotion of adequate nutrition early in life (e.g., exclusive breastfeeding) or changes in the food environment towards a reduction in the availability of energy-dense nutrient-poor foods, among others (Kennedy-Wood & Holschneider, 2021). Notwithstanding the attention that double-duty actions have generated and the potential effect that these may have in addressing multiple forms of malnutrition, the number of studies examining the impact of double-duty actions is very low (Menon & Peñalvo, 2020). Identifying specific interventions that simultaneously address maternal overweight/obesity and childhood anaemia is further hindered by the inability to determine the country-specific cause or causes of anaemia with the available data. Hence, in order to be able to design appropriate interventions to tackle the double burden of maternal overweight/obesity and childhood anaemia, a more comprehensive assessment of what is driving anaemia in different contexts is first needed (SPRING, 2017). Failure to do so, programmes will have limited impact in reducing anaemia and the double burden of overweight/obesity and anaemia at the three levels.

In conclusion, there is a high burden of intra-household double burden of overweight/obesity and anaemia in the 49 LMICs included in the study, primarily driven by households with overweight/obesity among mothers and anaemia among children. South Africa bears the highest burden of any intra-household dual burden with almost 1 in 3 households affected. Large inequalities exist in the distribution of mothers with overweight/obesity and children with anaemia, with the highest prevalence observed in the richest wealth quintile, highest maternal education level and urban areas. Double-duty approaches that target maternal overweight/obesity and childhood anaemia concurrently might help accelerate action towards reducing malnutrition in all its forms; nevertheless, understanding what causes anaemia in each LMIC is first needed in order to design effective interventions.

6.4. Chapter summary

In this chapter, the results of the study on the magnitude, distribution, and inequalities of the intra-household DBM among mothers and their children under-5 were presented and discussed.

KEY FINDINGS

- The pooled prevalence of total intra-household double burden of overweight/obesity and anaemia was 17.2% (95% CI: 15.6, 18.8) for the 49 LMICs included in the analysis; 16.2% (95% CI: 14.6, 17.9) for mothers with overweight/obesity and children with anaemia; and 2.8% (95% CI: 2.5, 3.1) for mothers with anaemia and children with overweight/obesity.
- The inequality analysis yielded differences in the distribution of the intra-household DBM by subgroups.
- Overall, households with mothers with overweight/obesity and children with anaemia followed an inverse social gradient (i.e., higher estimates found in the richest group, highest maternal education level and in urban areas); whereas the opposite was observed for mothers with anaemia and children with overweight/obesity.
- Variations in the intra-household DBM distribution were also observed across regions.

The following chapter briefly compares and discusses two inequality measures (i.e., simple/gaps vs. complex/SII) for the study of wealth and education-related inequalities in the distribution of the double burden of malnutrition at the individual and household levels.

CHAPTER 7

Wealth and education-related inequalities in the distribution of the double burden of malnutrition: simple vs. complex measures of inequality

7.1. Chapter overview

This chapter compares wealth and education-related inequalities in the distribution of the DBM using simple (i.e., inequality gaps or Gaps) vs. complex measures of inequality (i.e., slope index of inequality or SII). Inequalities in the distribution of the intra-individual and intra-household DBM using simple measures of inequality were presented in Chapter 5 and 6, respectively. Nevertheless, to facilitate comparison of both inequality measures, gaps are also displayed in this chapter's tables, next to the corresponding SII for every country. Findings are presented for the following forms of DBM: 1) intra-individual DBM among adult women; 2) intra-individual DBM among adolescent girls; 3) intra-individual DBM among children; 4) maternal overweight/obesity and childhood anaemia; and 5) maternal anaemia and childhood overweight/obesity. Further, to allow exploring patterns of inequality, country-specific stratified DBM prevalence estimates by household wealth and education level presented in the previous two chapters are displayed here in the form of equiplots. The results section is followed by a short discussion section, where the advantages and disadvantages of using each inequality measure are discussed, and the implications for health policy are considered.

7.2. Results

7.2.1. Inequalities in the distribution of the intra-individual double burden of overweight/obesity and anaemia among adult women

Table 7.1 shows wealth and education-related inequalities in the intra-individual DBM among adult women (20-49 years old), using both, simple (i.e., Gap) vs. complex (i.e., SII) measures of inequality. Overall, these indicate similar findings regardless of the type of inequality measure employed: the prevalence of concurrent overweight/obesity and anaemia is higher among adult women in the richest quintiles and those with higher levels of education in most countries. There are however a few inconsistencies in Burkina Faso (Gap: -2.8; SII: 9.5), Gabon (Gap: 1.3; SII: -3.7), Guinea (Gap: -2.1; SII: 4.1), Lesotho (Gap: -1.4; SII: 8.3), Tajikistan (Gap: 0.2; SII: -4.9) and Guyana (Gap: 3.7; SII: -1.7) for the education-related inequalities. Findings were also inconsistent in Albania for the wealth-related inequality (Gap: 0.0; SII: -0.1); although in this case, both values were close to zero. Interestingly, for the previous six instances, the distribution pattern of the DBM magnitude is not ordered, meaning that the prevalence of DBM did not increased monotonically following the education index. The latter can be observed in **Figure 7.1 B**, where the prevalence for each education level and household wealth quintile (**Figure 7.1 A**) is displayed.

Using the SII, of the 46 LMICs with data for wealth and education, the prevalence of concurrent overweight/obesity and anaemia among adult women was: 1) higher in the wealthiest groups and women with higher levels of education in 34 countries; 2) higher in the wealthiest groups and women with lower levels of education in eight countries (Gabon, Azerbaijan, Tajikistan, Guatemala, Guyana, Peru, Maldives and Cambodia); 3) higher in the poorest groups and women with lower levels of education in three countries (Jordan, Albania and Bolivia); and 4) higher in the poorest groups and women with higher levels of education in one country (Egypt) (**Table 7.1**).

Vast within country wealth-related inequalities (SII> 20.0) were observed in ten countries (**Table 7.1**). Ordered in decreasing order, the countries with a SII>20.0 were Yemen, Togo, Congo, Nigeria, Benin, Cameroon, Haiti, Ghana, Tanzania and India, ranging from 29.7 to 20.6. This means that the difference between the top and bottom of the wealth scale in these countries were as large as 20.0 pp; almost a 30.0 pp difference in Yemen. In comparison, education-related inequalities, were smaller, but as high as 18.2 in Maldives, 17.6 in Cameroon, 17.4 in Nigeria and 15.2 in Congo.

Different patterns in the distribution of DBM can be observed in **Figure 7.1**. Countries are displayed by amplitude (i.e., from widest to narrowest distance from the quintile or education level with the highest prevalence to that with the lowest prevalence). The majority of countries present an ordered distribution of the DBM prevalence across household wealth quintiles; however, this is not common across education levels. For example, Yemen in **Figure 7.1 A** shows a clear ordered and monotonic distribution of DBM prevalence from the lowest to the highest household wealth quintile; whereas Niger in **Figure 7.1 B** is an example of a non-ordered distribution, as the second highest prevalence of DBM is among women with primary education, rather than secondary education. An inverse ordered distribution is also observed, for instance, in Maldives by education level (**Figure 7.1 B**). Besides, “linear” (i.e., distance between subgroups is similar) and “top” (i.e., women in the wealthiest quintiles or highest education levels showing markedly higher prevalence than the other groups) inequality patterns can also be identified in both figures. For instance, in **Figure 7.1 A**, Yemen would be an example of “linear” inequality; whereas Tanzania would be one of “top” inequality. “Bottom” inequality patterns (i.e., women in the poorest quintiles or lowest education levels showing markedly higher prevalence than the other groups), were not as common among adult women, but can be observed for Maldives in **Figure 7.1 B**.

Table 7.1. Simple vs. complex measures of wealth and education-related inequality in the intra-individual DBM among adult women (20-49 years old).

	Wealth		Education	
Country and survey year	**Gap**	**SII**	**Gap**	**SII**
AFRICAN REGION				
Benin 2017-18	20.2**	24.7**	9.5**	7.8*
Burkina Faso 2010	9.3**	12.3**	-2.8**	9.5**
Burundi 2016-17	3.3**	4.1**	1.2**	3.7**
Cameroon 2011	18.5**	23.0**	9.0**	17.6**
Congo 2011-12	19.1**	25.4**	14.1*	15.2*
Cote d'Ivoire 2011-12	15.8**	19.2**	6.4	5.7*
DRC 2013-14	11.9**	16.6**	9.9**	10.0**
Eswatini 2006-07	11.5**	14.7**	4.9	3.2
Ethiopia 2016	2.2**	3.5**	2.2**	3.2**
Gabon 2012	17.7**	19.0**	1.3	-3.7
Gambia 2013	2.9*	6.8*	3.6	0.5
Ghana 2014	19.7**	21.1**	9.9*	12.6**
Guinea 2018	13.6**	17.0**	-2.1	4.1
Lesotho 2014	9.0**	12.2**	-1.4	8.3*
Madagascar 2008-09	3.6**	5.1**	0.5**	2.8*
Malawi 2015-16	7.4**	10.7**	3.1*	2.9
Mali 2018	8.6**	11.5**	5.2	1.8
Mozambique 2011	15.1**	19.5**	11.4**	11.7**
Namibia 2013	5.5**	8.4**	3.4	2.5
Niger 2012	11.7**	13.1**	19.6**	9.3**
Nigeria 2018	19.3**	25.2**	13.9**	17.4**

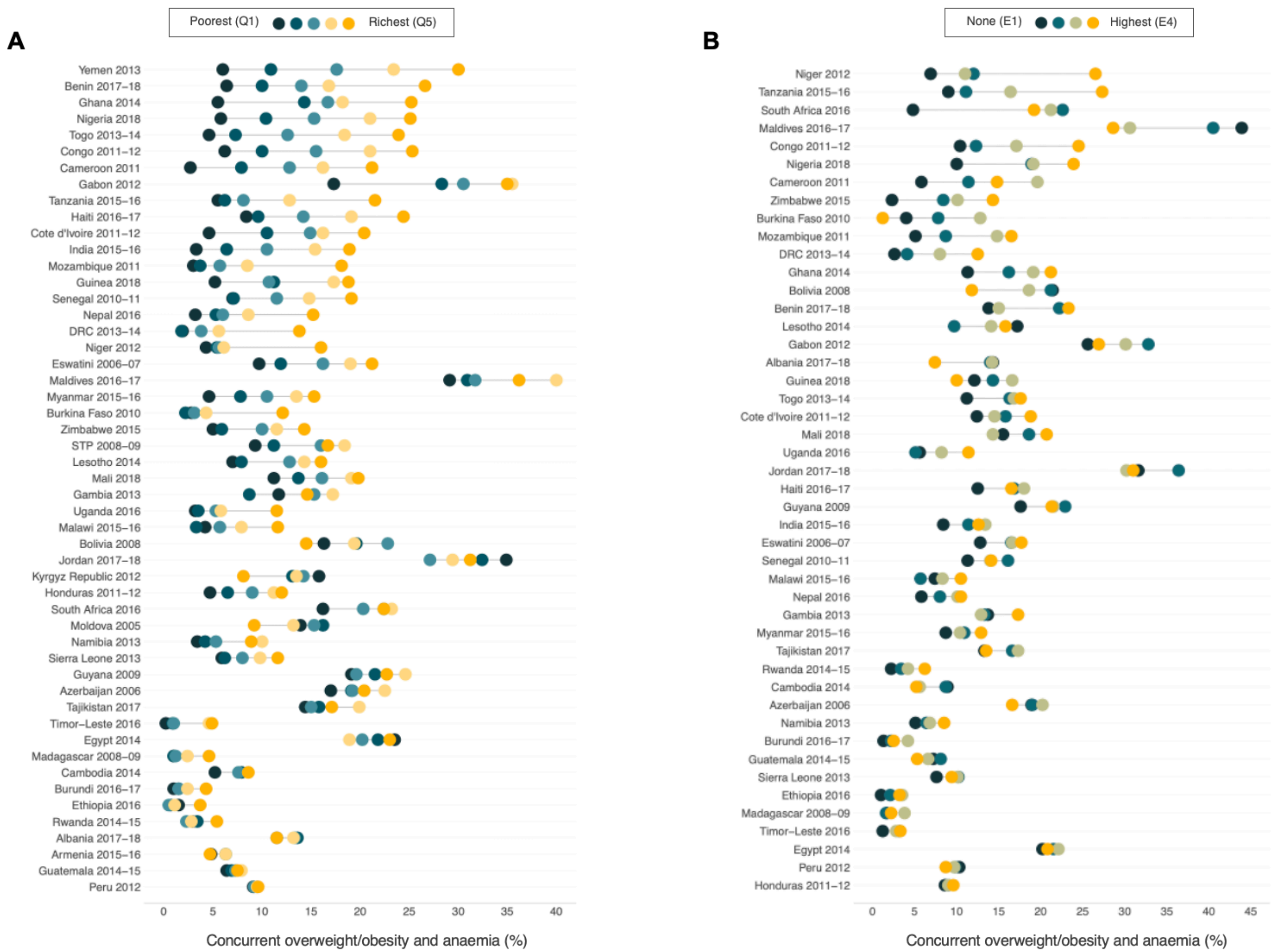
*p-value <0.05; **p-value <0.001
Missing values are due to low sample sizes (i.e., one or more subgroups with <25 observations) or education level data not available for Yemen.
DRC: Democratic Republic of the Congo; STP: Sao Tome and Principe.

Table 7.1. (continued)

	Wealth		Education	
Country and survey year	**Gap**	**SII**	**Gap**	**SII**
AFRICAN REGION				
Rwanda 2014-15	2.5*	2.5*	4.0*	2.9*
STP 2008-09	7.4	10.3*	-	-
Senegal 2010-11	12.1**	16.4**	2.8	6.5*
Sierra Leone 2013	5.7**	7.7**	1.8	4.4
South Africa 2016	6.2	6.8	14.4	0.8
Tanzania 2015-16	16.0**	20.6**	18.3**	10.1**
Togo 2013-14	19.3**	26.0**	6.4*	8.8**
Uganda 2016	8.3**	11.2**	5.8*	6.3*
Zimbabwe 2015	9.3**	12.6**	12.0**	6.5**
EASTERN MEDITERRANEAN REGION				
Egypt 2014	-0.5	-1.8	0.6	1.6
Jordan 2017-18	-3.7	-5.1	-0.6	-1.8
Yemen 2013	24.0**	29.7**	-	-
EUROPEAN REGION				
Albania 2017-18	0.0	-0.1	-6.9**	-7.8**
Armenia 2015-16	-0.1	-0.3	-	-
Azerbaijan 2006	3.4	4.9	-2.3	-6.4
Kyrgyz Republic 2012	-7.7**	-8.4**	-	-
Moldova 2005	-4.7**	-7.3**	-	-
Tajikistan 2017	2.7*	4.8*	0.2*	-4.9*
AMERICAS REGION				
Bolivia 2008	-1.8*	-3.8	-9.6**	-12.9**
Guatemala 2014-15	1.1	1.5	-1.9*	-2.1*
Guyana 2009	3.6	4.9	3.7	-1.7
Haiti 2016-17	16.0**	21.8**	4.0*	5.4*
Honduras 2011-12	7.3**	9.4**	1.0	0.5
Peru 2012	0.5	0.4	-1.6	-1.6
SOUTHEAST ASIAN REGION				
India 2015-16	15.6**	20.6**	4.2**	7.2**
Maldives 2016-17	7.1*	11.5*	-15.3**	-18.2**
Myanmar 2015-16	10.7**	13.5**	4.2	2.6
Nepal 2016	12.0**	14.4**	4.7**	7.3*
Timor-Leste 2016	4.7**	7.4**	2.1	2.5*
SOUTHEAST ASIAN REGION				
Cambodia 2014	3.4*	3.7*	-3.7**	-5.3**

*p-value <0.05; **p-value <0.001
Missing values are due to low sample sizes (i.e., one or more subgroups with <25 observations) or education level data not available for Yemen.
DRC: Democratic Republic of the Congo; STP: Sao Tome and Principe.

Figure 7.1. Country-level distribution of the intra-individual DBM among adult women by household wealth (A) and education level (B).



7.2.2. Inequalities in the distribution of the intra-individual double burden of overweight/obesity and anaemia among adolescent girls

Findings among adolescent girls (15-19 years old) echoed those of adult women. **Table 7.2** shows similar results in wealth and education-related inequalities by use of simple and complex measures of inequality. Likewise, there are however a few inconsistencies by education level: Burundi (Gap: -1.4; SII: 0.3), Congo (Gap: 1.0; SII: -3.5), Guatemala (Gap: -2.2; SII: 0.3), Haiti (Gap: -5.0; SII: 6.1) and Nepal (Gap: -1.7; SII: 0.1). These countries all had a non-ordered distribution of the DBM magnitude (**Figure 7.2 B**). In Madagascar, findings seemed also contradicting (Gap: 0.1; SII: -0.0), but both values are almost 0.0, indicating no inequality.

Of the 31 LMICs with SII values for both socioeconomic measures, the prevalence of concurrent overweight/obesity and anaemia among adolescent girls was: 1) higher in the wealthiest groups and girls with higher levels of education in 21 countries; 2) higher in the wealthiest groups and girls with lower levels of education in seven countries (Congo, Cote d'Ivoire, Ethiopia, Mali, Myanmar, Timor-Leste and Cambodia); 3) higher in the poorest groups and girls with lower levels of education in one country (Azerbaijan); and 4) similar for all wealth and education subgroups in two countries (Madagascar and Guatemala). The combination with intra-individual DBM prevalence being higher in the poorest groups and girls with higher levels of education was not observed in any country (**Table 7.2**).

Large inequalities were also identified for adolescent girls, but overall, widths were smaller than those observed among adult women. Only for the wealth-related inequality in Togo, the SII value was >20.0 (**Table 7.2**). In Cameroon, Cote d'Ivoire, Ghana, Malawi, Mozambique, Yemen and Albania, the SII value for household wealth was >10.0; whereas in Nigeria the SII for both socioeconomic measures were >10.0.

Figure 7.2 allows for the identification of patters in the distribution of the DBM among adolescent girls. Ordered distributions were more infrequent in **Figure 7.2 A** when compared to **Figure 7.1 A**, but observed in countries such as Togo, Yemen or Guinea, among others. "Top" inequality patterns seem to be common, with Albania being a clear example of this. **Figure 7.2 B** shows a mix of patterns, with ordered and non-ordered distributions, and a combination of "linear" (e.g., Honduras), "top" (e.g., Uganda) and "bottom" (e.g., Cambodia) inequality patterns.

Table 7.2. Simple vs. complex measures of wealth and education-related inequality in the intra-individual DBM among adolescent girls (15-19 years old).

	Wealth		**Education**	
Country and survey year	**Gap**	**SII**	**Gap**	**SII**
AFRICAN REGION				
Benin 2017-18	6.3*	8.1*	2.6	4.6*
Burkina Faso 2010	4.8*	7.0*	4.3*	5.7*
Burundi 2016-17	1.2	1.9	-1.4	0.3
Cameroon 2011	9.7**	11.4**	5.0	5.4
Congo 2011-12	1.0	3.4	1.0	-3.5
Cote d'Ivoire 2011-12	7.1	10.8*	-5.6	-8.9*
DRC 2013-14	5.4*	6.8*	1.8	1.7
Eswatini 2006-07	6.1	7.0*	-	-
Ethiopia 2016	1.9*	2.4	-1.0	-0.9
Gabon 2012	1.9	0.4	-	-
Gambia 2013	4.6	5.3	1.1	1.7
Ghana 2014	11.6**	16.4**	6.2	7.2
Guinea 2018	6.7*	9.4*	3.7	6.6*
Lesotho 2014	2.3	5.7	-	-
Madagascar 2008-09	0.1	0.6	0.1	-0.0
Malawi 2015-16	7.4**	11.2*	5.3	5.5*
Mali 2018	4.1	4.6	-0.7	-1.7
Mozambique 2011	7.3**	10.2**	4.4*	6.2*
Namibia 2013	2.8	4.2	-	-
Niger 2012	2.7	3.1	0.2	1.1
Nigeria 2018	8.2**	11.7**	5.8**	12.9**
Rwanda 2014-15	0.6	1.5	-	-
STP 2008-09	-3.1	-6.7	-	-
Senegal 2010-11	4.5	6.2	1.1	2.0
Sierra Leone 2013	0.7	2.9	2.0	0.4
South Africa 2016	2.6	1.2	-	-
Tanzania 2015-16	5.8*	6.8*	3.9	3.0

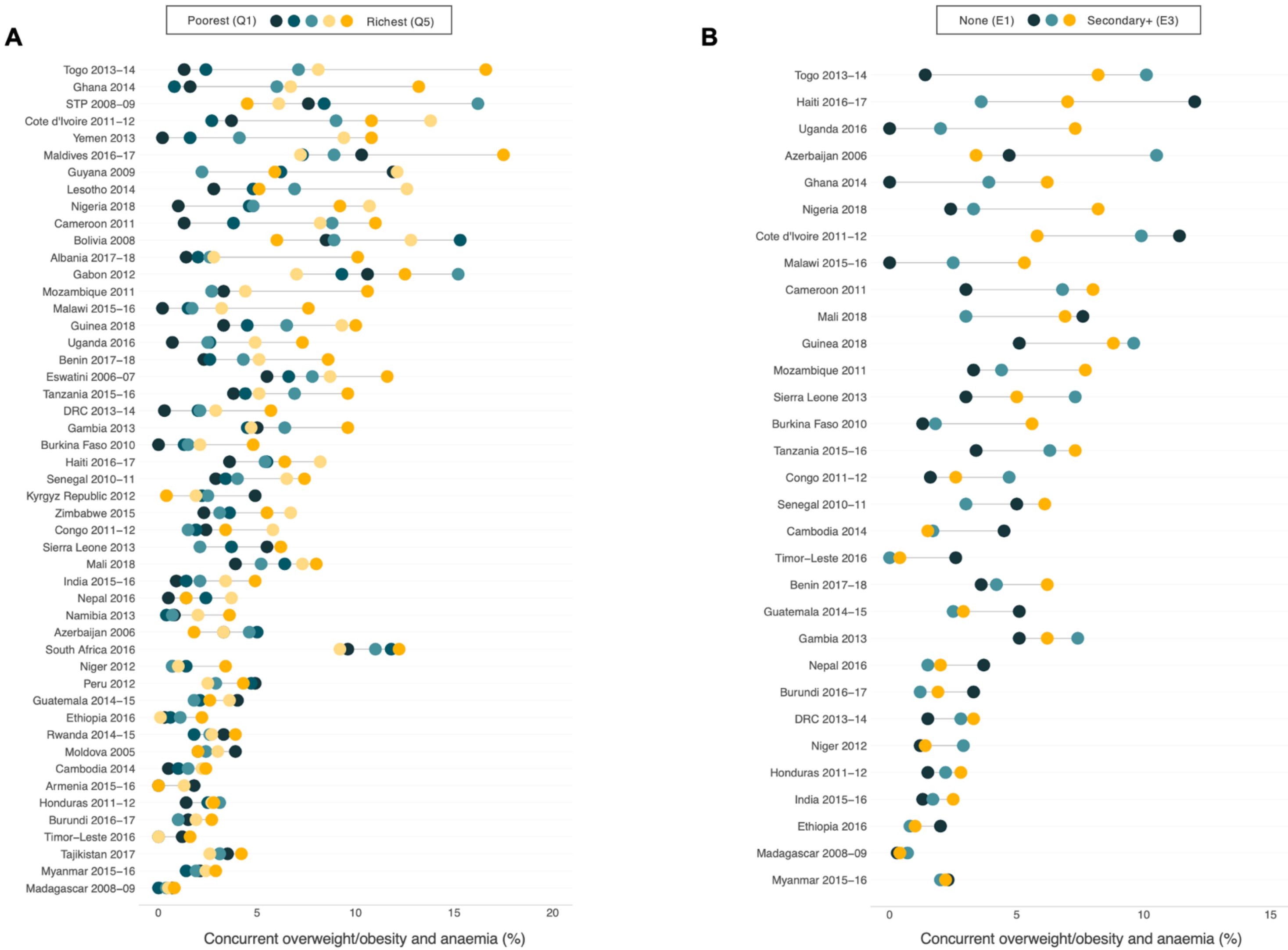
*p-value <0.05; **p-value <0.001
Missing values are due to low sample sizes (i.e., one or more subgroups with <25 observations) or education level data not available for Yemen.
DRC: Democratic Republic of the Congo; STP: Sao Tome and Principe.

Table 7.2. (continued)

	Wealth		Education	
Country and survey year	**Gap**	**SII**	**Gap**	**SII**
AFRICAN REGION				
Togo 2013-14	15.3**	21.8**	6.8	2.3
Uganda 2016	6.6*	9.0*	7.3**	9.9*
Zimbabwe 2015	3.2	4.7*	-	-
EASTERN MEDITERRANEAN REGION				
Egypt 2014	-	-	-	-
Jordan 2017-18	-	-	-	-
Yemen 2013	10.6**	15.0**	-	-
EUROPEAN REGION				
Albania 2017-18	8.7**	10.1*	-	-
Armenia 2015-16	-1.8	-1.4	-	-
Azerbaijan 2006	-1.5	-2.7	-1.3	-8.9*
Kyrgyz Republic 2012	-4.5*	-5.1*	-	-
Moldova 2005	-1.9	-1.4	-	-
Tajikistan 2017	0.7	0.4	-	-
AMERICAS REGION				
Bolivia 2008	-2.5	-5.7	-	-
Guatemala 2014-15	-1.4*	-0.3	-2.2	0.3
Guyana 2009	-6.0*	-2.2	-	-
Haiti 2016-17	2.8	4.0	-5.0*	6.1
Honduras 2011-12	1.4	1.4	1.3	1.1
Peru 2012	-0.6	-1.6	-	-
SOUTHEAST ASIAN REGION				
India 2015-16	4.0**	5.0**	1.2**	1.7**
Maldives 2016-17	7.2	6.5	-	-
Myanmar 2015-16	0.8	1.4	-0.1	-0.3
Nepal 2016	0.9	1.9	-1.7	1.1
Timor-Leste 2016	0.4	0.9	-2.2	-1.2
SOUTHEAST ASIAN REGION				
Cambodia 2014	1.9	2.5*	-3.0	-0.8

*p-value <0.05; **p-value <0.001
Missing values are due to low sample sizes (i.e., one or more subgroups with <25 observations) or education level data not available for Yemen.
DRC: Democratic Republic of the Congo; STP: Sao Tome and Principe.

Figure 7.2. Country-level distribution of the intra-individual DBM among adolescent girls by household wealth (A) and education level (B).



7.2.3. Inequalities in the distribution of the intra-individual double burden of overweight/obesity and anaemia among children

Table 7.3. displays wealth and maternal education-related inequalities in the intra-individual DBM among children (6-59 months). When comparing inequality gaps with SII values, findings were contradicting in 11 instances for the analysis by household wealth and in 12 occasions by maternal education level. Of these, both measures indicated almost no wealth or maternal education-related inequalities with values in the range -1.0 to 1.0. However, differences were more substantial for others, notably in Madagascar (Gap: 7.9; SII: -0.3) and Sierra Leone (Gap: 13.0; SII: -1.9) by maternal education level.

The SII for countries with available values for the two sociodemographic measures (n=40) indicate that the prevalence of intra-individual DBM among children was: 1) higher in the wealthiest groups and highest maternal education levels in 15 countries; 2) higher in the wealthiest groups and lowest maternal education levels in seven countries (Angola, Mali, Mozambique, Niger, Rwanda, Nepal and Cambodia); 3) higher in the poorest groups and lowest maternal education levels in 11 countries; 4) higher in the poorest groups and highest maternal education levels in six countries (Benin, Burundi, Democratic Republic of the Congo, Eswatini, Ghana and Egypt); and 5) similar across all wealth subgroups but higher among the highest maternal education levels in one country (Myanmar) (**Table 7.3**).

Overall, small inequalities were observed among children for both sociodemographic measures, with 48 and 39 LMICs showing a SII value <5.0 by household wealth and maternal education level, respectively (**Table 7.3**). In contrast, South Africa and Uganda presented large wealth-related inequalities (SII >10.0).

Patterns in the distribution of the intra-individual DBM prevalence were non-ordered for the majority of LMICs by household wealth and maternal education level, with a very few exceptions (**Figure 7.3**). In Uganda, children in the wealthiest quintiles show markedly higher prevalence than the other groups; while a clear “top” inequality pattern is also observed in Sierra Leone and Madagascar by maternal education level. “Bottom” inequality patterns are also observed, such as in South Africa by household wealth and Mozambique by maternal education level; although patterns are overall less marked than those observed for adult women and adolescent girls.

Table 7.3. Simple vs. complex measures of wealth and education-related inequality in the intra-individual DBM among children (6-59 months).

	Wealth		Education	
Country and survey year	**Gap**	**SII**	**Gap**	**SII**
AFRICAN REGION				
Angola 2015-16	0.8	1.0	-0.7	-0.7
Benin 2017-18	0.2	-0.1	2.3	0.5
Burkina Faso 2010	-0.3	-0.2	-	-
Burundi 2016-17	-0.6	-0.5	-0.9	0.1
Cameroon 2011	1.2*	1.3	3.3*	4.3*
Congo 2011-12	2.1	2.2	0.5	0.3
Cote d'Ivoire 2011-12	0.3	-0.4	-	-
DRC 2013-14	-0.7	-1.3	-2.4	0.4
Eswatini 2006-07	-0.6	-1.3	2.2	0.7
Ethiopia 2016	0.5*	1.5	2.1*	1.5
Gabon 2012	3.5	3.1	-1.9	0.1
Gambia 2013	0.6	0.8	0.9	2.2
Ghana 2014	0.3	-0.2	-0.1	0.5
Guinea 2018	3.2*	2.0	2.1	5.5*
Lesotho 2014	-1.6	-3.2	-	-
Madagascar 2003-04	1.4	-0.1	7.9	-0.3
Malawi 2015-16	0.1	-0.5	-2.8	-1.0
Mali 2018	0.6	1.0	-0.8	-1.3
Mozambique 2011	0.0	0.1	-7.0	-2.9
Namibia 2013	3.2	3.3	2.4	1.6
Niger 2012	0.6	0.9	1.6	-0.3
Nigeria 2018	-1.1*	-1.4*	-1.5*	-1.3*
Rwanda 2014-15	-0.1	0.1	-2.7	-0.7
STP 2008-09	0.1	-1.3	-	-
Senegal 2010-11	-1.3	-1.0	-	-
Sierra Leone 2013	-5.0	-5.0*	13.0*	-1.9
South Africa 2016	-7.3	-11.0*	-	-
Tanzania 2015-16	1.5	1.2	3.2	1.0

*p-value <0.05; **p-value <0.001
Missing values are due to low sample sizes (i.e., one or more subgroups with <25 observations) or education level data not available for Yemen.
DRC: Democratic Republic of the Congo; STP: Sao Tome and Principe.

Table 7.3. (continued)

	Wealth		Education	
Country and survey year	**Gap**	**SII**	**Gap**	**SII**
AFRICAN REGION				
Togo 2013-14	0.6	0.4	0.8	0.7
Uganda 2016	9.5	10.3*	1.0	4.7
Zimbabwe 2015	1.8	2.2	-0.3	1.2
EASTERN MEDITERRANEAN REGION				
Egypt 2014	-1.6	-1.0	1.4	1.0
Jordan 2012	-0.5	-1.9	-0.5	-0.4
Yemen 2013	-0.4	0.5	-	-
EUROPEAN REGION				
Albania 2017-18	-3.2	-5.0*	-	-
Armenia 2015-16	2.4	1.7	-	-
Azerbaijan 2006	0.5	0.4	-	-
Kyrgyz Republic 2012	-0.1	0.6	-	-
Moldova 2005	1.6	0.7	-	-
Tajikistan 2017	-0.3	-0.2	0.4	-0.2
AMERICAS REGION				
Bolivia 2008	-1.9*	-4.5	1.3	-3.1
Guatemala 2014-15	-0.5	-0.7	-0.3	-0.4
Guyana 2009	0.0	2.4	3.4	4.4
Haiti 2016-17	0.2	-0.1	-0.9	-1.2
Honduras 2011-12	-0.6	-0.4	-0.2	-0.8
Peru 2012	1.3	2.0*	1.5	0.6
SOUTHEAST ASIAN REGION				
India 2015-16	0.8**	0.9**	0.8**	0.8**
Maldives 2016-17	-2.2	-0.5	-1.5	-0.1
Myanmar 2015-16	1.7	-0.0	2.1	1.8
Nepal 2016	0.2	0.7	1.2	-0.3*
Timor-Leste 2016	0.2	0.9	0.1	0.8
SOUTHEAST ASIAN REGION				
Cambodia 2014	0.9	0.5	1.6	-0.8

*p-value <0.05; **p-value <0.001
Missing values are due to low sample sizes (i.e., one or more subgroups with <25 observations) or education level data not available for Yemen.
DRC: Democratic Republic of the Congo; STP: Sao Tome and Principe.

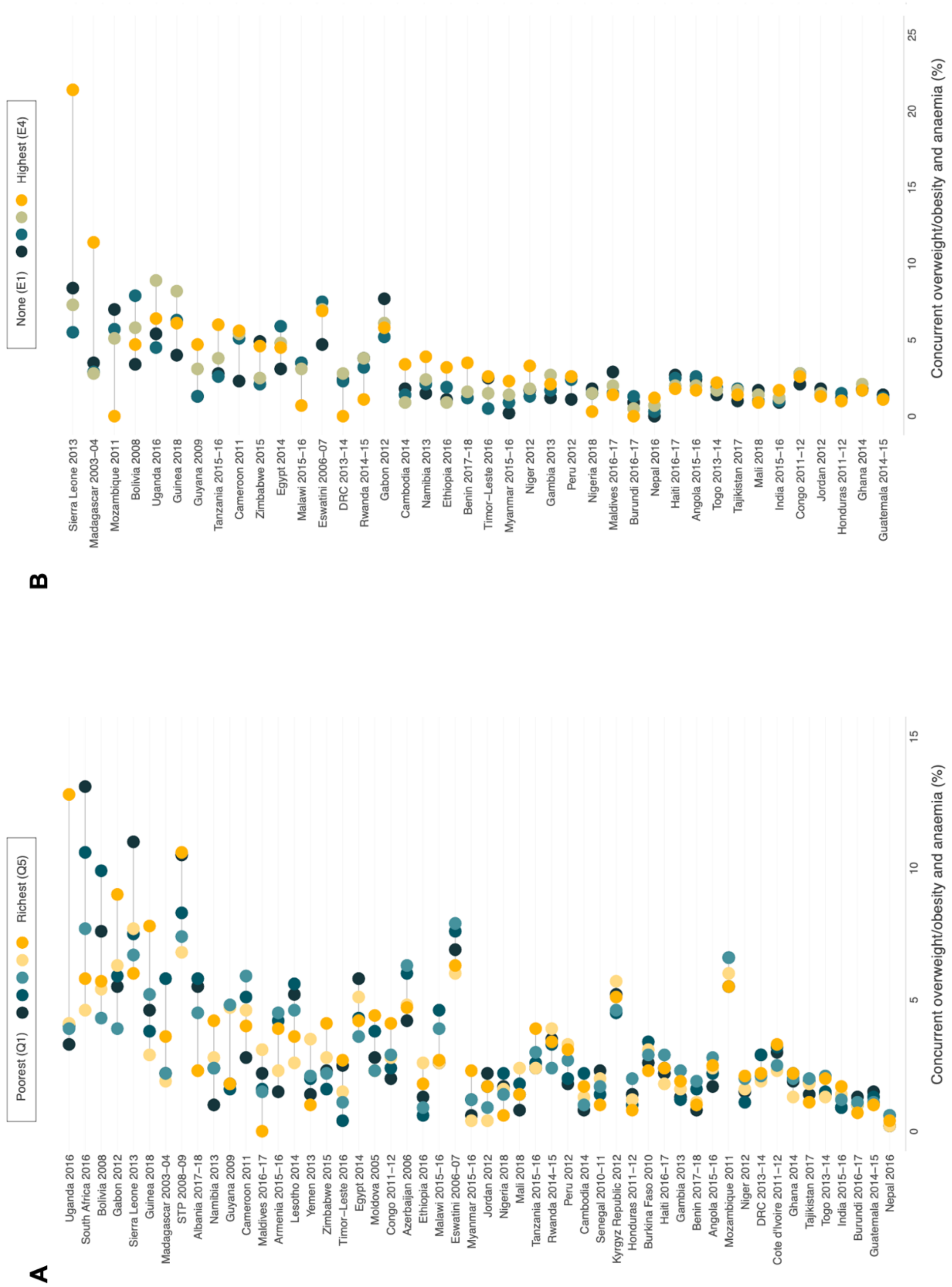


Figure 7.3. Country-level distribution of the intra-individual DBM among children by household wealth (A) and education level (B).

7.2.4. Inequalities in the distribution of maternal overweight/obesity and childhood anaemia

Findings at the intra-household level for the form with mothers with overweight/obesity and children with anaemia were similar, regardless of measure of inequality used (**Table 7.4**). However, these were contradicting in three instances by household wealth: South Africa (Gap: 2.3; SII: -4.4), Bolivia (Gap: -0.9; SII: 3.1) and Guatemala (Gap: -0.8; SII: 0.3); and in Cambodia (Gap: 5.7; SII: -2.2) by maternal education level. As observed with other DBM forms, the distribution of the intra-household DBM was non-ordered in these countries, and one of the middle groups normally presented the highest prevalence estimate (**Figure 7.4**).

Using the SII, of the 35 LMICs with data for the two sociodemographic characteristics, the prevalence of maternal overweight/obesity and childhood anaemia was: 1) higher in the wealthiest groups and households with higher levels of maternal education in 23 countries; 2) higher in the wealthiest groups and households with lower levels of maternal education in eight countries (Gabon, Gambia, Malawi, Bolivia, Guatemala, Honduras, Maldives and Cambodia); and 3) higher in the poorest groups and households with lower levels of maternal education in four countries (Egypt, Tajikistan, Guyana and Peru) (**Table 7.4**).

Inequalities for maternal overweight/obesity and childhood anaemia were overall larger than those observed for other forms of DBM at the individual and household level. Wealth-related inequalities reached a SII value >20.0 in 15 countries, ranging from 20.1 in Burkina Faso to 36.7 in Togo (**Table 7.4**). Ordered in decreasing order, countries with a SII >30.0 were Togo, Yemen, Guinea, Ghana, Nigeria, Mali and Haiti. Education-related inequalities were also very large in some countries, with Cameroon, Nigeria and Ghana presenting SII values >20.0 (**Table 7.4**).

The main patterns observed in **Figure 7.4 A** for the distribution of maternal overweight/obesity and childhood anaemia by household wealth were “linear” (e.g., Togo, Guinea, Ghana or India) and “top” inequality patterns (e.g., Niger, Mali, Benin, Congo, Burkina Faso, Mozambique, Sierra Leone or Ethiopia). A mix of ordered and non-ordered distributions can be observed for this form of intra-household DBM by household wealth; and no “bottom” inequality patterns were identified. By maternal education level, a mix of ordered and non-ordered distributions are also noticeable, with some apparent “top” inequality patterns in countries with the highest amplitude in the distribution of the DBM magnitude (e.g., Ghana, Benin, Tanzania, and Congo);

whereas in Gambia or Bolivia, the prevalence was concentrated in households with none, primary or secondary maternal education levels (**Figure 7.4 B**).

Table 7.4. Simple vs. complex measures of wealth and education-related inequality in the intra-household DBM for the form maternal overweight/obesity and childhood anaemia.

	Wealth		Education	
Country and survey year	**Gap**	**SII**	**Gap**	**SII**
AFRICAN REGION				
Benin 2017-18	21.6**	25.4**	25.5**	11.0**
Burkina Faso 2010	17.9**	20.1**	-	-
Burundi 2016-17	10.8**	12.7**	5.7**	6.3**
Cameroon 2011	21.7**	26.9**	20.0**	25.3**
Congo 2011-12	23.5**	26.5**	20.1*	18.1*
Cote d'Ivoire 2011-12	19.1**	24.1**	-	-
DRC 2013-14	18.2**	19.6**	17.7**	10.8**
Eswatini 2006-07	6.6	10.7*	1.0	0.3
Ethiopia 2016	8.3**	8.6**	13.0**	6.6**
Gabon 2012	6.7*	11.3*	-1.3	-5.8
Gambia 2013	2.4	5.1	-15.4	-5.6
Ghana 2014	25.2**	32.2**	28.0*	21.0**
Guinea 2018	27.5**	33.2**	8.5**	15.2*
Lesotho 2014	12.0*	13.6*	-	-
Malawi 2015-16	9.1**	12.4**	-3.2*	-1.3
Mali 2018	23.7**	30.3**	13.8**	19.8**
Mozambique 2011	17.2**	18.7**	7.8**	8.8**
Namibia 2013	11.6**	19.4**	0.9	7.1
Niger 2012	23.7**	26.2**	-	-
Nigeria 2018	23.2**	31.8**	21.3**	25.9**
Rwanda 2014-15	9.0**	10.6**	5.6*	8.8*
STP 2008-09	6.8	11.2	-	-
Senegal 2010-11	14.9*	19.0**	-	-
Sierra Leone 2013	17.0**	17.9**	3.3	2.5

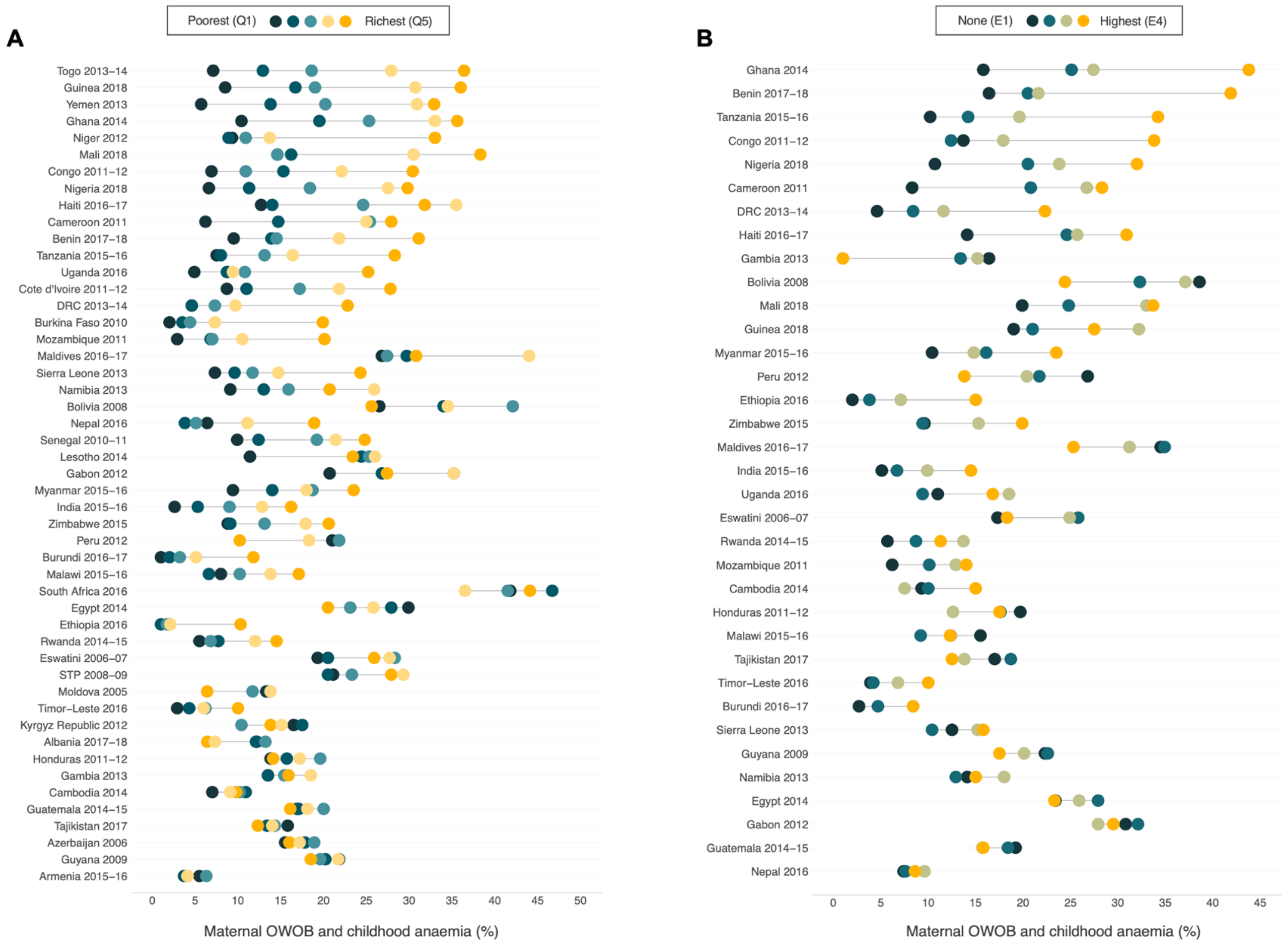
*p-value <0.05; **p-value <0.001
Missing values are due to low sample sizes (i.e., one or more subgroups with <25 observations) or education level data not available for Yemen.
DRC: Democratic Republic of the Congo; STP: Sao Tome and Principe.

Table 7.4. (continued)

	Wealth		Education	
Country and survey year	**Gap**	**SII**	**Gap**	**SII**
AFRICAN REGION				
South Africa 2016	2.3	-4.4	-	-
Tanzania 2015-16	20.8**	23.9**	24.0**	12.0**
Togo 2013-14	29.3**	36.7**	-	-
Uganda 2016	20.3**	22.2**	5.8**	12.0*
Zimbabwe 2015	11.8**	16.1**	10.3**	13.1**
EASTERN MEDITERRANEAN REGION				
Egypt 2014	-9.4*	-9.5*	-0.1	-0.9
Yemen 2013	27.2**	35.0**	-	-
EUROPEAN REGION				
Albania 2017-18	-5.8	-7.5*	-	-
Armenia 2015-16	-1.4	-1.1	-	-
Azerbaijan 2006	0.5	0.8	-	-
Kyrgyz Republic 2012	-2.7	-3.6	-	-
Moldova 2005	-6.9	-7.1	-	-
Tajikistan 2017	-3.5	-3.0	-4.5	-5.4
AMERICAS REGION				
Bolivia 2008	-0.9*	3.1	-14.2*	-3.6
Guatemala 2014-15	-0.8	0.3	-3.4	-4.9*
Guyana 2009	-3.3	-2.8	-4.8	-5.3
Haiti 2016-17	19.1**	30.1**	16.8**	14.2**
Honduras 2011-12	0.3*	2.3	-2.2**	-8.4*
Peru 2012	-10.8**	-9.8**	-13.0**	-11.0**
SOUTHEAST ASIAN REGION				
India 2015-16	13.6**	18.0**	9.4**	11.6**
Maldives 2016-17	4.0*	12.5*	-9.2	-11.1*
Myanmar 2015-16	14.1**	16.4**	13.1*	7.1
Nepal 2016	12.5**	14.2**	1.2	2.8
Timor-Leste 2016	7.1	7.9*	6.1	6.8
SOUTHEAST ASIAN REGION				
Cambodia 2014	2.8	2.5	5.7	-2.2

*p-value <0.05; **p-value <0.001
Missing values are due to low sample sizes (i.e., one or more subgroups with <25 observations) or education level data not available for Yemen.
DRC: Democratic Republic of the Congo; STP: Sao Tome and Principe.

Figure 7.4. Country-level distribution of maternal overweight/obesity and childhood anaemia by household wealth (A) and education level (B).



7.2.5. Inequalities in the distribution of maternal anaemia and childhood overweight/obesity

Table 7.5 displays wealth and maternal education-related inequalities in maternal anaemia and childhood overweight/obesity, using both, simple vs. complex measures of inequality. There are inconsistencies by household wealth in Benin (Gap: 0.0; SII: -0.1 0.6), Gambia (Gap: -0.6; SII: 0.6), Ghana (Gap: 0.5; SII: -0.2), Azerbaijan (Gap: 1.2; SII: -1.9) and Maldives (Gap: -2.8; SII: 1.8); and by maternal education level in Burundi (Gap: -0.7; SII: 0.5), Cameroon (Gap: -0.6; SII: 2.8), Congo (Gap: -0.6; SII: 0.5), Democratic Republic of the Congo (Gap: -1.6; SII: 1.5), Ghana (Gap: 0.8; SII: -0.7), Mali (Gap: -1.5; SII: 0.5), Namibia (Gap: 0.0; SII: -1.3), Tanzania (Gap: -1.3; SII: 0.0), Tajikistan (Gap: 0.9; SII: -0.3), Guatemala (Gap: 0.8; SII: -0.3) and Guyana (Gap: -1.7; SII: 1.2). This could be the result of a combination of several factors, including overall very small inequalities by the two sociodemographic characteristics (i.e., values close to 0), and non-ordered distributions, as evidenced by **Figure 7.5**.

Of the 35 LMICs with SII values for both socioeconomic measures, the prevalence of maternal anaemia and childhood overweight/obesity was: 1) higher in the wealthiest groups and households with higher levels of maternal education in 15 countries; 2) higher in the wealthiest groups and households with lower levels of maternal education in four countries (Gabon, Malawi, Tajikistan and Haiti); 3) higher in the poorest groups and households with lower levels of education in eight countries (Ghana, Mozambique, Namibia, Nigeria, Rwanda, Sierra Leone, Bolivia and Guatemala); 4) higher in the poorest groups and households with higher levels of education in seven countries (Benin, Burundi, Democratic Republic of the Congo, Ethiopia, Uganda, Guyana and Nepal); and 5) higher in the poorest groups and same across all maternal education levels in Tanzania (**Table 7.5**).

Small inequalities were observed for both sociodemographic measures, with all LMICs showing a SII value <5.0, except for Namibia (SII: -7.7) and South Africa (SII: -6.9) by household wealth, and Bolivia by maternal education level (SII: -6.5) (**Table 7.5**).

Patterns in the DBM distribution were non-ordered for the majority of countries, and no marked patterns could be observed (**Figure 7.5**); although with the exception of a clear “bottom” inequality pattern in Ethiopia and a “top” inequality pattern in Peru by household wealth (**Figure 7.5 A**). By maternal education level, a “top” inequality pattern could be identified in countries such as Eswatini, Zimbabwe, Honduras or Myanmar; whereas, for example, the prevalence was concentrated in households with the other three maternal education levels in Mozambique or Rwanda, or those with secondary education in Guinea or Ethiopia (**Figure 7.5 B**).

Table 7.5. Simple vs. complex measures of wealth and education-related inequality in the intra-household DBM for the form maternal anaemia and childhood overweight/obesity.

	Wealth		Education	
Country and survey year	**Gap**	**SII**	**Gap**	**SII**
AFRICAN REGION				
Benin 2017-18	0.0	-0.1	0.1	0.1
Burkina Faso 2010	-1.3	-1.6	-	-
Burundi 2016-17	-0.4	-0.3	-0.7	0.5
Cameroon 2011	0.7	0.7	-0.6	2.8
Congo 2011-12	1.6	1.1	-0.6	0.5
Cote d'Ivoire 2011-12	1.4	1.2	-	-
DRC 2013-14	-0.8	-0.5	-1.6	1.5
Eswatini 2006-07	2.3	2.2	3.1	2.5
Ethiopia 2016	-2.1*	-2.3	0.0	1.3
Gabon 2012	0.3	1.7	-4.4	-2.8
Gambia 2013	-0.6	0.6	0.9	1.3
Ghana 2014	0.5	-0.2	0.8	-0.7
Guinea 2018	1.9	1.5	0.1	1.7
Lesotho 2014	-1.5*	-3.3*	-	-
Malawi 2015-16	0.8	1.0	-2.3	-1.1
Mali 2018	0.2	0.2	-1.5	0.5
Mozambique 2011	-1.5	-1.0	-6.8	-2.6
Namibia 2013	-0.9	-7.7	0.0	-1.3
Niger 2012	-0.1	-0.1	-	-
Nigeria 2018	-0.7	-1.2	-1.1	-1.1
Rwanda 2014-15	-2.2*	-3.4*	-3.2	-1.3
STP 2008-09	4.0	2.9	-	-
Senegal 2010-11	-1.3	-0.2	-	-
Sierra Leone 2013	-3.9	-3.4	-2.1	-3.3

*p-value <0.05; **p-value <0.001
Missing values are due to low sample sizes (i.e., one or more subgroups with <25 observations) or education level data not available for Yemen.
DRC: Democratic Republic of the Congo; STP: Sao Tome and Principe.

Table 7.5. (continued)

	Wealth		Education	
Country and survey year	**Gap**	**SII**	**Gap**	**SII**
AFRICAN REGION				
South Africa 2016	-2.4	-6.9*	-	-
Tanzania 2015-16	-0.1	-0.2	-1.3	0.0
Togo 2013-14	1.4	1.5	-	-
Uganda 2016	-0.9	-0.3	0.4	0.8
Zimbabwe 2015	1.3	1.6	2.3*	0.7
EASTERN MEDITERRANEAN REGION				
Egypt 2014	2.7**	4.3*	1.2	0.4
Yemen 2013	-3.4	-3.4	-	-
EUROPEAN REGION				
Albania 2017-18	-0.7	-1.6	-	-
Armenia 2015-16	-3.0	-3.5*	-	-
Azerbaijan 2006	1.2	-1.9	-	-
Kyrgyz Republic 2012	-0.1	-0.0	-	-
Moldova 2005	-0.7	-2.6	-	-
Tajikistan 2017	0.5	0.4	0.9	-0.3
AMERICAS REGION				
Bolivia 2008	-3.8	-4.4	-4.4	-6.5*
Guatemala 2014-15	-0.6*	-0.3	0.8	-0.3
Guyana 2009	-3.8*	-4.5	-1.7	1.2
Haiti 2016-17	1.0	0.8	-0.9	-0.3
Honduras 2011-12	1.8**	1.8*	2.2**	1.4*
Peru 2012	2.4*	2.7*	2.3*	2.6*
SOUTHEAST ASIAN REGION				
India 2015-16	0.4*	0.6*	0.3	0.3
Maldives 2016-17	-2.8*	1.8	0.7	0.7
Myanmar 2015-16	1.5	1.2	1.8	1.3
Nepal 2016	-0.6	-1.1	1.1	1.4
Timor-Leste 2016	2.8	3.0	2.0	2.1
SOUTHEAST ASIAN REGION				
Cambodia 2014	0.5	0.8	1.5	0.8

*p-value <0.05; **p-value <0.001
Missing values are due to low sample sizes (i.e., one or more subgroups with <25 observations) or education level data not available for Yemen.
DRC: Democratic Republic of the Congo; STP: Sao Tome and Principe.

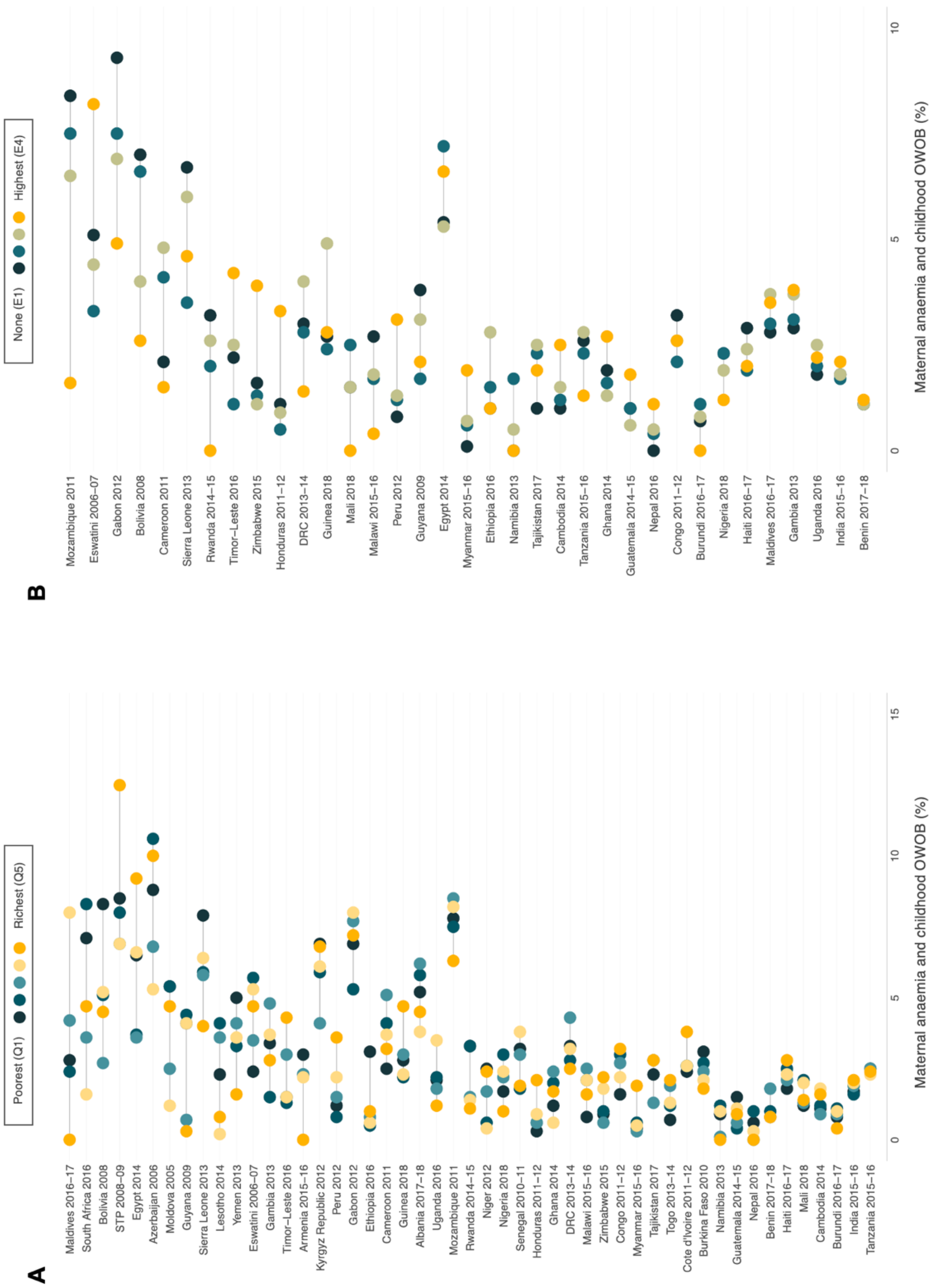


Figure 7.5. Country-level distribution of maternal anaemia and childhood overweight/obesity by household wealth (A) and education level (B).

7.3. Discussion

This chapter compared findings in the distribution of five forms of DBM at the individual and household level by use of simple (i.e., Gap) vs. complex (i.e., SII) measures of inequality. The analyses performed for this chapter of whether the distribution of DBM is mostly concentrated in high or low wealth quintiles and education levels complements the findings presented in Chapter 5 and 6, whereby the highest prevalence is often observed in the richest wealth quintiles and those with higher levels of education for the intra-individual DBM among adult women and adolescent girls and maternal overweight/obesity and childhood anaemia, whereas little differences exist across subgroups for the intra-individual DBM among children and maternal anaemia and childhood overweight/obesity.

Over the past decades, multiple measures have been put forward to express the magnitude of inequalities (Wagstaff et al., 1991; Mackenbach & Kunst, 1997; Harper & Lynch, 2005); and there seems to be no single measure of inequality that reveals the full picture (Harper & Lynch, 2005; Moser et al., 2007; Barros & Victora, 2013). Inequality gaps are easy to compute and represent the absolute difference in pp between the extreme wealth quintiles or education levels; however, these have important limitations (Barros & Victora, 2013). First, this method assumes that the lowest and highest prevalence correspond with the highest and lowest quintile or education level, which is not always the case. For example, the highest and lowest prevalence estimates were found in middle groups in a moderate number of countries, particularly for the intra-individual DBM among children and maternal anaemia and childhood overweight/obesity. In these cases, the inequality gap fails to show the full extent of the magnitude of inequality, and in some cases, contradicting results were found in the present study (i.e., positive gap values and negative SII values, or viceversa). To counteract this limitation, Jiwani et al. (2019) defined inequality gaps in their study as “the absolute difference in pp between the highest and lowest most extreme outcome prevalence estimates within each socioeconomic status measure”. Nevertheless, the latter method does not account for the natural ordering of the sociodemographic measure (i.e., from poorest to richest or from the least to the most educated), which has been argued somewhere else (Mujica & Victora, 2019). Second, gaps are sensitive to changes in the number of categories within one sociodemographic measure, meaning that the gap value will change if, for example, deciles are used instead of quintiles, since the DBM prevalence for the most extreme groups will change accordingly (Barros & Victora, 2013). By contrast, the SII, which is being increasingly used to measure absolute inequalities, are unaffected by the choice of quantiles and account for the whole distribution of a population sample (Harper & Lynch, 2005; Mujica & Victora, 2019). The SII is derived through logistic regression of the outcome of interest (e.g., intra-individual and intra-household DBM) on the mid points of the ranks obtained by ordering the sample by the explanatory variable, ranging from zero to one (Mujica & Victora, 2019; International Center for Equity in Health, n.d.). Thus, for instance, when using wealth quintiles, the midpoints are close to 0.1, 0.3, 0.5, 0.7, and 0.9, and it is assumed that each group comprises approximately 20% of the sample. The latter is not always true when studying the DBM, and it depends on data availability throughout the different subgroups (see sociodemographic characteristics tables on Chapters 5 and 6). The SII value corresponds with the slope of the resulting regression line, which represents the absolute difference in the fitted value of the DBM between the highest and lowest sociodemographic ranks (Mujica & Victora, 2019; International Center for Equity in Health, n.d.).

Furthermore, in this chapter, equiplots displaying the distribution of the different forms of DBM for the two sociodemographic measures at the country-level are presented. This allowed to explore in more depth the DBM distribution, by assessing inequality patterns, which can then be utilised to inform health policy and programme development within countries. Overall, a mix of patterns were observed, with some clear “top” inequality patterns in some countries when investigating inequalities by household wealth and education level, particularly for the intra-individual DBM among adult women and adolescent girls and maternal overweight/obesity and childhood anaemia. Likewise, the most common combination observed for all DBM forms was: highest prevalence of DBM among individuals/households in the richest groups and highest levels of education. However, it is worth noting a few issues. First, conclusions at the global level on the distribution of intra-individual and intra-household DBM must be drawn with caution due to important variations in patterns observed across LMICs. Second, “top” inequality patterns identified in certain countries, should not necessarily translate into policies and programmes that only address those in the richest quintiles and higher education levels, to avoid a “bottom” inequality pattern from evolving as countries go through the different stages of the nutrition transition (Barros & Victora, 2013; Jiwani et al., 2019).

A limitation of this chapter is that only absolute measures of inequality were calculated and compared. Indicators of relative inequality (e.g., the concentration index (CIX) or the relative index of inequality (RII)) are increasingly reported together with absolute measures, as they might help providing a better picture of the extent of inequalities for a given outcome in a country (Harper & Lynch, 2005; Moser et al., 2007; Barros & Victora, 2013; WHO, 2013b; Mujica & Victora, 2019). The CIX is the most common complex measure to summarise relative inequality, derived by using an analogous approach to the Gini index, and indicates the extent to which a health indicator is concentrated among the disadvantaged or the advantaged; whereas the RII is generated in the same manner as the SII, but represents the ratio between the fitted values for one and zero (Barros & Victora, 2013; WHO, 2013b; Restrepo-Méndez, 2015).

In conclusion, although overall similar findings were obtained when using both, simple and complex measures of inequality, the latter might be a better method to use when assessing inequalities in the double burden of overweight/obesity and anaemia. Inconsistencies in results were sometimes observed when the distribution of the DBM was not ordered and differences across subgroups were very small. Different patterns were identified in LMICs for the different DBM forms, with "top" inequality being the most repeated.

7.4. Chapter summary

In this chapter, findings in the distribution of five forms of DBM at the individual and household level by use of simple (i.e., Gap) vs. complex (i.e., SII) measures of inequality are presented, compared, and discussed.

KEY FINDINGS

- Overall, similar findings were observed when using both measures; although with some inconsistencies.
- The use of SII might be preferred over inequality gaps, particularly when the distribution of the outcome of interest is not ordered, as complex measures of inequality consider all sociodemographic subgroups within a sample and are unaffected by the choice of quantiles.

The next chapter represents the last results and discussion chapter. In this one, the focus shifts to the intra-individual double burden of overweight/obesity and anaemia among adult women (20-49 years old) only, for whom the overall pooled prevalence of DBM was 12.4% (range: 1.7% to 33.6%), to document trends in LMICs over the past two decades, overall and by sociodemographic characteristics.

CHAPTER 8

Trends in the magnitude and inequalities of the intra-individual double burden of overweight/obesity and anaemia among non-pregnant adult women living in 33 low- and middle-income countries

8.1. Chapter overview

This chapter constitutes the third and final study of the PhD thesis. First, results of the trends analysis on the magnitude and inequalities of the intra-individual DBM among adult women are presented. This section opens with a brief description of the characteristics of the surveys employed, and it is followed by two main subsections: 1) trends in the magnitude of the DBM and 2) trends in inequalities in the distribution of the DBM. Results are presented overall, by WHO region, and World Bank Income classification. To better understand trends in the magnitude of the intra-individual DBM among adult women, estimate values (i.e., AARC) are also displayed for overweight/obesity and anaemia separately. Second, the findings are discussed and the limitations and strengths of this study are highlighted.

8.2. Results

8.2.1. Characteristics of surveys

The analytical sample comprised a total of 1,128,815 adult women (20-49 years old) with available anthropometric and anaemia data living across 33 LMICs (n=95 datasets between 2000 and 2019). The total number of countries represented in this analysis included 21 from the African region (n=58 datasets), 2 from the Eastern Mediterranean region (n=7 datasets), 2 from the European region (n=5 datasets), 4 from the Americas region (n=14 datasets), 3 from the Southeast Asian region (n=7 datasets) and 1 from the Western Pacific region (n=4 datasets). All countries had at least one dataset in the year range 2000-2009 and the most recent dataset in the category 2010-2019, with the exception of Burundi, Gambia, Madagascar and Bolivia. Using the latest World Bank Income classification, 13 countries were low-income, all located within the African region; 16 were lower-middle-income from all WHO regions except the European region; and four were upper-middle-income located in the Eastern Mediterranean, European and Americas regions.

Sample sizes by country are presented in **Table 8.1**, together with the national prevalence of concurrent overweight/obesity and anaemia, overweight/obesity, and anaemia for the 95 DHS surveys included in the study. The highest prevalence of DBM was found in Egypt (2005), where 31.1% of adult women were identified to be simultaneously affected by overweight/obesity and anaemia. The lowest DBM prevalence was estimated in Ethiopia (2011), with only 0.7% of the female adult population presenting both forms of malnutrition. In total, six surveys had DBM estimates above 20%, all of them from the Eastern Mediterranean region; while 23 had prevalence estimates below 5%. The remaining 66 surveys had DBM prevalence values between 5% and 30%. The highest and lowest prevalence of overweight/obesity was also found in Egypt for the year 2014 (85.4%) and Ethiopia for the year 2005 (4.6%), respectively. For anaemia, the highest prevalence was observed in Benin for the year 2001 (63.3%); while the lowest estimate was found in Armenia (2000) at 12.9%.

Stratified estimates and inequality measures of concurrent overweight/obesity and anaemia by household wealth, education level and area of residence can be found in **Tables 8.2, 8.3** and **8.4**. A total of 48 prevalence estimates by household wealth (richest: n=18; richer: n=10; middle: n=8; poorer: n=6; poorest: n=6), 26 by education level (secondary or higher: n=8; primary: n=11; no education: n=7), and 55 by area of residence (capital cities: n=27; other urban: n=9; total urban: n=14; rural: n=5) had values above 20% for the double burden of overweight/obesity and anaemia. In terms of inequality measures, absolute and relative measures of inequality were positive in 86/95 surveys by household wealth (i.e., burden of DBM concentrated among the wealthiest groups), and 72/91 and 73/91 by education level (i.e., burden of DBM concentrated among more educated groups) for absolute and relative measures, respectively. By area of residence, gaps were positive in 89/95 surveys (i.e., burden of DBM concentrated among urban residents).

Table 8.1. National prevalence of concurrent overweight/obesity and anaemia, overweight/obesity, and anaemia among adult women (20-49 years old) in the 95 DHS surveys included in the study.

Country	Income*	Survey year	N	DBM % (95% CIs)	OWOB % (95% CIs)	Anaemia % (95% CIs)
AFRICAN REGION						
Benin	LMI	2001	2,070	13.3 [11.8, 14.9]	21.5 [19.3, 23.8]	63.3 [60.8, 65.7]
		2011	3,514	12.7 [11.4, 14.1]	31.5 [29.7, 33.3]	41.1 [39.1, 43.1]
		2017	5,274	15.7 [14.6, 16.9]	31.2 [29.6, 32.9]	55.7 [54.0, 57.4]
Burkina Faso	LI	2003	2,707	4.5 [3.8, 5.4]	9.9 [8.8, 11.1]	52.2 [50.3, 54.1]
		2010	5,671	5.3 [4.7, 6.0]	12.9 [11.7, 14.1]	47.5 [45.7, 49.3]
Burundi	LI	2010	2,794	1.3 [0.9, 1.8]	8.2 [7.3, 9.3]	17.8 [15.9, 19.9]
		2016	5,675	2.2 [1.8, 2.6]	8.8 [7.9, 9.9]	39.1 [37.4, 40.8]
Cameroon	LMI	2004	3,253	13.7 [12.6, 15.0]	32.5 [30.6, 34.4]	42.6 [40.7, 44.5]
		2011	5,148	13.2 [12.3, 14.4]	37.1 [35.4, 38.9]	37.8 [36.1, 39.5]
		2018	4,430	16.0 [14.5, 17.5]	42.8 [40.7, 45.0]	38.5 [36.5, 40.6]
Congo	LMI	2005	2,167	14.9 [12.9, 17.1]	30.0 [28.1, 32.0]	55.2 [52.2, 58.2]
		2011	3,779	15.9 [13.8, 18.1]	31.2 [28.7, 33.8]	53.7 [51.1, 56.2]
DRC	LI	2007	3,021	6.1 [5.3, 7.0]	14.0 [12.8, 15.3]	50.2 [48.4, 52.0]
		2013	5,930	5.7 [4.9, 6.6]	18.4 [16.3, 20.8]	36.9 [34.5, 39.4]

DBM, concurrent overweight/obesity and anaemia; OWOB, overweight/obesity; DRC, Democratic Republic of the Congo.
*Latest World Bank Income classification: LI, low-income; LMI, lower-middle-income; UMI, upper-middle-income.

Table 8.1. (continued)

Country	Income*	Survey year	N	DBM % (95% CIs)	OWOB % (95% CIs)	Anaemia % (95% CIs)
AFRICAN REGION						
Ethiopia	Li	2005	3,921	1.0 [0.7, 1.4]	4.6 [3.6, 5.7]	25.7 [23.7, 27.8]
		2011	10,317	0.7 [0.5, 1.0]	6.7 [5.8, 7.8]	16.6 [15.2, 18.1]
		2016	9,878	1.7 [1.3, 2.1]	8.7 [7.5, 21.9]	23.6 [21.8, 25.4]
Gambia	LI	2013	2,923	13.7 [12.2, 15.3]	26.7 [24.6, 28.6]	59.2 [56.3, 62.1]
		2019	3,914	16.5 [14.9, 18.2]	43.7 [41.4, 46.1]	42.8 [40.0, 45.6]
Ghana	LMI	2003	3,620	10.3 [9.2, 11.6]	29.4 [27.5, 31.5]	43.0 [41.0, 45.0]
		2008	3,276	18.5 [17.0, 20.1]	35.2 [33.2, 37.2]	56.9 [54.6, 59.3]
		2014	3,363	17.0 [15.2, 19.0]	47.1 [44.7, 49.6]	40.7 [38.5, 43.0]
Guinea	LI	2005	2,577	7.6 [6.5, 9.0]	16.4 [14.8, 18.1]	51.0 [48.8, 53.1]
		2012	3,065	8.8 [7.8, 10.1]	22.8 [20.8, 25.0]	47.4 [44.8, 50.0]
		2018	3,439	12.7 [11.4, 14.1]	31.5 [29.4, 33.8]	44.1 [42.1, 46.2]
Lesotho	LMI	2004	2,048	13.6 [11.9, 15.4]	46.8 [44.2, 49.4]	32.7 [30.1, 35.3]
		2009	2,732	11.1 [9.6, 12.8]	48.8 [46.3, 51.2]	26.6 [24.6, 28.8]
		2014	2,383	12.4 [10.9, 14.1]	51.9 [49.5, 54.3]	27.2 [25.2, 29.3]

DBM, concurrent overweight/obesity and anaemia; OWOB, overweight/obesity; DRC, Democratic Republic of the Congo.
*Latest World Bank Income classification: LI, low-income; LMI, lower-middle-income; UMI, upper-middle-income.

Table 8.1. (continued)

Country	Income*	Survey year	N	DBM % (95% CIs)	OWOB % (95% CIs)	Anaemia % (95% CIs)
AFRICAN REGION						
Madagascar	LI	2003	1,802	2.1 [1.6, 2.8]	7.6 [6.4, 9.1]	42.8 [39.4, 46.3]
		2008	5,585	2.2 [1.8, 2.7]	7.7 [6.8, 8.8]	35.3 [33.6, 37.1]
Malawi	LI	2004	1,779	5.2 [4.1, 6.6]	15.8 [13.9, 17.9]	43.2 [40.6, 45.9]
		2010	4,817	4.5 [3.9, 5.3]	20.1 [18.6, 21.6]	27.6 [25.8, 29.4]
		2015	5,553	6.8 [6.0, 7.6]	24.6 [23.2, 26.0]	30.5 [28.9, 32.1]
Mali	LI	2001	2,275	8.8 [7.2, 10.6]	16.9 [14.8, 19.2]	61.5 [59.1, 63.8]
		2006	2,976	11.1 [8.6, 14.4]	22.3 [19.0, 25.9]	59.5 [57.1, 61.8]
		2012	3,505	8.3 [7.3, 9.3]	20.6 [18.8, 22.5]	49.6 [47.6, 51.6]
		2018	3,375	15.8 [14.3, 17.4]	31.5 [29.0, 34.0]	61.8 [59.4, 64.2]
Niger	LI	2006	2,758	4.7 [3.9, 5.8]	15.7 [14.2, 17.4]	41.4 [39.0, 43.9]
		2012	3,303	7.7 [6.6, 8.9]	20.7 [18.9, 22.7]	42.2 [39.7, 44.7]

DBM, concurrent overweight/obesity and anaemia; OWOB, overweight/obesity; DRC, Democratic Republic of the Congo.
*Latest World Bank Income classification: LI, low-income; LMI, lower-middle-income; UMI, upper-middle-income.

Table 8.1. (continued)

Country	Income*	Survey year	N	DBM % (95% CIs)	OWOB % (95% CIs)	Anaemia % (95% CIs)
AFRICAN REGION						
Rwanda	LI	2005	3,667	2.9 [2.3, 3.5]	12.1 [10.9, 13.4]	25.7 [24.0, 27.5]
		2010	4,790	2.7 [2.2, 3.3]	17.9 [16.8, 19.1]	17.3 [16.2, 18.5]
		2014	4,685	3.4 [3.0, 4.0]	22.9 [21.6, 24.3]	18.6 [17.2, 20.0]
		2019	5,057	2.8 [2.3, 3.4]	29.7 [28.1, 31.4]	11.5 [10.5, 12.6]
Senegal	LMI	2005	2,752	15.1 [13.3, 17.0]	27.8 [25.2, 30.7]	57.0 [54.5, 59.6]
		2010	3,614	12.8 [11.1, 14.7]	25.8 [23.3, 28.4]	53.4 [50.9, 55.9]
Sierra Leone	LI	2008	2,418	14.1 [12.2, 16.2]	31.4 [28.3, 34.8]	43.8 [41.3, 46.3]
		2013	5,271	8.4 [7.4, 9.6]	21.6 [19.8, 23.5]	42.0 [39.3, 44.7]
		2019	5,052	12.9 [11.9, 14.1]	32.6 [30.8, 34.4]	44.5 [42.5, 46.6]
Tanzania	LMI	2004	6,612	8.4 [7.5, 9.5]	20.8 [19.4, 22.4]	45.3 [43.4, 47.2]
		2010	6,593	8.6 [7.7, 9.6]	24.8 [23.1, 26.5]	37.2 [35.7, 39.0]
		2015	8,791	12.0 [11.1, 13.0]	33.5 [31.9, 35.2]	42.3 [40.6, 43.9]

DBM, concurrent overweight/obesity and anaemia; OWOB, overweight/obesity; DRC, Democratic Republic of the Congo.
*Latest World Bank Income classification: LI, low-income; LMI, lower-middle-income; UMI, upper-middle-income.

Table 8.1. (continued)

Country	Income*	Survey year	N	DBM % (95% CIs)	OWOB % (95% CIs)	Anaemia % (95% CIs)
AFRICAN REGION						
Uganda	LI	2000	4,096	3.4 [2.7, 4.1]	14.7 [13.3, 16.3]	35.9 [34.0, 37.9]
		2006	1,765	6.1 [4.9, 7.6]	18.8 [16.5, 21.5]	41.1 [38.2, 44.1]
		2011	1,693	3.5 [2.7, 4.5]	21.3 [19.3, 23.3]	23.2 [21.2, 25.2]
		2016	3,868	6.4 [5.5, 7.5]	27.9 [25.9, 29.9]	29.5 [27.7, 31.4]
Zimbabwe	LMI	2005	5,309	8.9 [8.1, 9.8]	28.9 [26.9, 30.8]	37.2 [35.1, 39.4]
		2010	5,636	8.8 [7.9, 9.7]	36.4 [34.9, 37.9]	28.2 [26.8, 29.7]
		2015	6,515	9.9 [9.0, 10.9]	41.2 [39.5, 42.9]	26.3 [24.9, 27.7]
EASTERN MEDITERRANEAN REGION						
Egypt	LMI	2000	6,422	20.4 [19.0, 21.8]	78.8 [77.5, 80.1]	27.4 [25.9, 28.9]
		2005	5,322	31.3 [31.3, 31.4]	81.7 [81.7, 81.8]	39.1 [39.1, 39.1]
		2014	6,077	21.4 [20.0, 22.8]	85.4 [84.3, 86.5]	25.6 [24.1, 27.2]

DBM, concurrent overweight/obesity and anaemia; OWOB, overweight/obesity; DRC, Democratic Republic of the Congo.
*Latest World Bank Income classification: LI, low-income; LMI, lower-middle-income; UMI, upper-middle-income.

Table 8.1. (continued)

Country	Income*	Survey year	N	DBM % (95% CIs)	OWOB % (95% CIs)	Anaemia % (95% CIs)
EASTERN MEDITERRANEAN REGION						
Jordan	UMI	2002	1,468	19.3 [16.8, 22.0]	69.3 [66.1, 72.3]	27.4 [24.3, 30.6]
		2007	4,147	24.2 [24.1, 24.4]	67.8 [67.7, 68.0]	36.4 [36.2, 36.5]
		2012	5,902	25.8 [23.9, 27.7]	72.0 [70.0, 73.9]	36.9 [34.8, 38.9]
		2017	5,879	30.9 [29.1, 32.8]	69.9 [67.9, 71.8]	44.7 [42.4, 47.0]
EUROPEAN REGION						
Albania	UMI	2008	5,796	9.1 [8.1, 10.1]	46.8 [45.1, 48.5]	19.2 [17.8, 20.8]
		2017	12,360	12.6 [11.8, 13.5]	60.8 [59.4, 62.2]	21.7 [20.5, 22.9]
Armenia	UMI	2000	4,795	5.2 [4.5, 5.9]	47.2 [45.7, 48.7]	12.3 [11.2, 13.5]
		2005	4,838	10.6 [9.5, 11.8]	49.1 [47.0, 51.1]	23.1 [21.2, 25.0]
		2015	4,868	5.7 [4.8, 6.7]	49.9 [48.2, 51.6]	12.9 [11.5, 14.5]
AMERICAS REGION						
Bolivia	LMI	2003	4,147	15.2 [13.7, 16.9]	53.7 [51.7, 55.8]	31.8 [30.0, 33.8]
		2008	4,063	18.5 [17.0, 20.1]	56.7 [54.7, 58.7]	36.5 [34.6, 38.5]

DBM, concurrent overweight/obesity and anaemia; OWOB, overweight/obesity; DRC, Democratic Republic of the Congo.
*Latest World Bank Income classification: LI, low-income; LMI, lower-middle-income; UMI, upper-middle-income.

Table 8.1. (continued)

Country	Income*	Survey year	N	DBM % (95% CIs)	OWOB % (95% CIs)	Anaemia % (95% CIs)
AMERICAS REGION						
Haiti	LMI	2000	3,136	12.8 [10.3, 15.8]	28.2 [24.7, 32.1]	53.1 [49.8, 56.3]
		2005	3,483	9.6 [8.3, 11.1]	26.0 [24.2, 28.0]	43.4 [41.1, 45.7]
		2012	6,400	13.1 [11.9, 14.4]	31.1 [29.3, 33.0]	46.9 [45.1, 48.7]
		2016	6,587	16.6 [15.3, 17.9]	38.5 [37.0, 40.2]	47.0 [45.3, 48.7]
Honduras	LMI	2005	12,941	9.0 [8.3, 9.7]	53.9 [52.9, 55.0]	18.3 [17.2, 19.4]
		2011	15,323	9.1 [8.5, 9.7]	60.0 [58.9, 61.0]	15.5 [14.7, 16.2]
Peru	UMI	2000	4,559	15.5 [14.3, 16.9]	54.3 [52.4, 56.1]	30.8 [29.0, 32.5]
		2007	18,728	13.1 [12.3, 13.8]	54.8 [53.6, 56.0]	25.8 [24.7, 26.8]
		2009	16,798	10.8 [10.2, 11.6]	57.8 [56.7, 59.0]	20.3 [19.3, 21.3]
		2010	16,649	10.4 [9.8, 11.1]	57.6 [56.5, 58.7]	20.9 [20.0, 21.8]
		2011	16,716	8.8 [8.2, 9.4]	59.3 [58.2, 60.5]	16.5 [15.7, 17.3]
		2012	17,898	9.4 [8.8, 10.0]	61.8 [60.7, 62.8]	16.8 [16.0, 17.7]

DBM, concurrent overweight/obesity and anaemia; OWOB, overweight/obesity; DRC, Democratic Republic of the Congo.
*Latest World Bank Income classification: LI, low-income; LMI, lower-middle-income; UMI, upper-middle-income.

Table 8.1. (continued)

Country	Income*	Survey year	N	DBM % (95% CIs)	OWOB % (95% CIs)	Anaemia % (95% CIs)
SOUTHEAST ASIAN REGION						
India	LMI	2005	84,976	7.7 [7.5, 7.9]	18.5 [18.2, 18.7]	51.3 [50.9, 51.6]
		2015	524,796	11.4 [11.2, 11.6]	24.3 [24.0, 24.5]	52.9 [52.6, 53.1]
Nepal	LMI	2006	7,598	2.2 [1.8, 2.8]	10.4 [8.9, 12.2]	34.1 [30.5, 37.9]
		2011	4,439	3.5 [2.8, 4.2]	16.3 [14.5, 18.4]	33.0 [30.6, 35.4]
		2016	4,787	8.0 [7.0, 9.2]	26.9 [24.7, 29.1]	39.5 [37.4, 41.8]
Timor-Leste	LMI	2009	2,696	1.5 [0.9, 2.3]	7.5 [6.2, 9.0]	19.7 [17.9, 21.6]
		2016	2,870	2.5 [1.9, 3.3]	13.5 [12.1, 15.1]	21.7 [19.8, 23.7]
WESTERN PACIFIC REGION						
Cambodia	LMI	2000	2,500	3.6 [2.8, 4.5]	8.6 [7.4, 10.0]	58.5 [56.3, 60.7]
		2005	5,875	3.6 [3.1, 4.2]	11.9 [10.7, 13.1]	45.8 [44.2, 47.4]
		2010	6,744	4.5 [3.8, 5.2]	13.2 [12.0, 14.6]	42.9 [41.4, 44.5]
		2014	8,703	7.7 [6.9, 8.4]	21.0 [19.9, 12.4]	43.8 [42.4, 45.1]

DBM, concurrent overweight/obesity and anaemia; OWOB, overweight/obesity; DRC, Democratic Republic of the Congo.
*Latest World Bank Income classification: LI, low-income; LMI, lower-middle-income; UMI, upper-middle-income.

Table 8.2. Trends in the prevalence of concurrent overweight/obesity and anaemia among adult women (20-49 years old) by household wealth.

		Household wealth quintiles*								
Country	**Survey year**	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AFRICAN REGION										
Benin	2001	5.1 [3.3, 8.0]	6.1 [4.2, 8.7]	8.9 [6.7, 11.7]	12.4 [10.0, 15.3]	29.2 [25.7, 32.9]	31.1	0.0000	4.0	0.2490
	2011	5.5 [4.1, 7.3]	8.5 [6.5, 11.0]	13.0 [10.6, 15.8]	14.7 [12.2, 17.6]	18.8 [15.8, 22.3]	16.9	0.0000	24.9	0.0000
	2017	6.4 [4.8, 8.5]	10.0 [8.1, 12.3]	14.0 [11.8, 16.5]	16.8 [14.3, 19.6]	26.6 [23.9, 29.5]	24.7	0.0000	24.4	0.0000
Burkina Faso	2003	1.4 [0.5, 3.0]	1.3 [5.1, 2.6]	2.4 [1.3,3.9]	3.5 [2.1, 5.6]	12.5 [10.0, 15.3]	15.5	0.0000	47.6	0.0000
	2010	2.8 [1.8, 4.2]	2.2 [1.4, 3.5]	3.1 [2.2, 4.5]	4.3 [2.9, 6.2]	12.1 [10.5, 13.7]	12.3	0.0000	33.7	0.0000
Burundi	2010	1.2 [0.5, 3.1]	0.2 [0.0, 1.5]	1.7 [0.9, 3.2]	0.8 [0.3, 2.2]	2.6 [1.7, 4.0]	3.4	0.0030	22.9	0.0670
	2016	1.0 [0.5, 2.0]	1.5 [0.9, 2.4]	1.5 [0.9, 2.6]	2.4 [1.6, 3.7]	4.3 [3.0, 6.2]	4.1	0.0000	26.5	0.0000
Cameroon	2004	3.9 [2.9, 5.2]	7.2 [5.6, 9.1]	13.8 [11.4, 16.5]	17.6 [14.5, 21.3]	23.3 [20.8, 26.0]	23.6	0.0000	29.7	0.0000
	2011	2.7 [1.6, 4.4]	7.9 [6.3, 9.9]	12.8 [10.6, 15.4]	16.2 [13.8, 18.8]	21.2 [18.9, 23.6]	23.0	0.0000	25.7	0.0000
	2018	3.3 [2.0, 5.4]	9.1 [7.2, 11.4]	14.7 [12.3, 17.4]	20.5 [17.8, 23.4]	26.5 [23.1, 30.3]	22.1	0.0000	28.9	0.0000
Congo	2005	10.0 [6.7, 14.6]	8.3 [5.9, 11.7]	13.7 [11.8, 16.0]	18.3 [15.2, 22.0]	21.6 [17.5, 26.3]	16.7	0.0000	19.2	0.0000
	2011	6.2 [5.0, 7.8]	10.0 [7.5, 13.0]	15.5 [11.6, 20.4]	21.0 [16.0, 27.2]	25.3 [20.0, 31.4]	25.4	0.0000	25.9	0.0000
DRC	2007	3.2 [2.0, 5.0]	1.9 [1.0, 3.5]	3.8 [2.4, 5.7]	5.8 [4.1, 8.0]	14.2 [11.7, 17.0]	15.1	0.0000	44.5	0.0000
	2013	1.9 [1.3, 2.9]	1.8 [1.1, 3.0]	3.8 [2.7, 5.5]	5.6 [3.6, 8.6]	13.8 [11.6, 16.5]	16.6	0.0000	39.8	0.0000

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest wealth values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicate that the richest have a greater DBM prevalence than the poorest; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.2. (continued)

		Household wealth quintiles*								
Country	**Survey year**	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AFRICAN REGION										
Ethiopia	2005	1.1 [0.4, 2.7]	1.0 [0.6, 1.5]	0.7 [0.3, 1.9]	0.4 [0.3, 0.4]	1.7 [1.2, 2.5]	1.7	0.0350	10.2	0.4880
	2011	1.1 [0.4, 2.7]	0.1 [0.0, 0.6]	0.5 [0.0, 0.2]	0.5 [0.3, 1.1]	1.9 [1.3, 2.9]	3.9	0.0000	44.5	0.0000
	2016	1.5 [0.9, 2.4]	0.7 [0.3, 1.5]	0.5 [0.2, 1.0]	1.1 [0.7, 2.0]	3.7 [2.8, 4.9]	3.5	0.0000	30.5	0.0000
Gambia	2013	11.7 [8.9, 15.3]	8.7 [6.5, 11.5]	15.3 [11.7, 19.7]	17.2 [13.7, 21.4]	14.6 [11.4, 18.6]	9.1	0.0000	9.0	0.0080
	2019	13.6 [11.5, 16.1]	16.2 [13.1, 19.8]	18.4 [14.8, 22.6]	20.9 [17.1, 25.4]	13.3 [10.7, 16.5]	3.4	0.0950	0.7	0.7820
Ghana	2003	3.7 [2.6, 5.2]	6.7 [5.0, 8.9]	7.3 [5.6, 9.4]	12.6 [10.3, 15.3]	17.7 [14.9, 20.9]	18.4	0.0000	27.6	0.0000
	2008	6.9 [4.9, 9.8]	11.2 [8.7, 14.3]	14.5 [12.0, 17.4]	25.7 [22.2, 29.5]	27.8 [23.8, 32.1]	29.8	0.0000	21.2	0.0000
	2014	5.5 [4.0, 7.6]	14.3 [11.4, 17.7]	16.7 [13.6, 20.4]	18.2 [14.5, 22.5]	25.2 [20.8, 30.2]	21.1	0.0000	20.0	0.0000
Guinea	2005	4.5 [2.8, 7.0]	3.0 [1.8, 5.0]	5.4 [4.0, 7.2]	7.6 [5.4, 10.6]	17.8 [14.4, 21.8]	14.1	0.0000	31.1	0.0000
	2012	3.3 [2.0, 5.4]	5.2 [3.5, 7.5]	8.2 [5.9, 11.3]	11.6 [9.0, 14.7]	14.6 [12.3, 17.2]	14.6	0.0000	25.3	0.0000
	2018	5.2 [3.8, 7.1]	11.2 [8.7, 14.5]	10.7 [8.2, 13.8]	17.3 [14.1, 21.0]	18.8 [15.8, 22.2]	17.0	0.0000	21.2	0.0000
Lesotho	2004	7.3 [6.0, 8.9]	10.1 [7.5, 13.6]	12.8 [10.2, 15.8]	16.4 [13.2, 20.1]	17.9 [14.5, 21.8]	16.6	0.0000	17.6	0.0000
	2009	6.1 [4.2, 8.8]	8.9 [6.5, 12.0]	10.1 [7.2, 14.0]	13.1 [9.7, 17.3]	13.7 [11.2, 16.6]	10.5	0.0000	13.1	0.0000
	2014	7.0 [4.6, 10.7]	7.9 [5.4, 11.2]	12.8 [9.6, 16.9]	14.3 [11.0, 18.5]	16.0 [12.7, 19.9]	12.2	0.0000	14.0	0.0000

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest wealth values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicate that the richest have a greater DBM prevalence than the poorest; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.2. (continued)

		Household wealth quintiles*								
Country	**Survey year**	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AFRICAN REGION										
Madagascar	2003	1.5 [0.6, 4.0]	1.6 [1.3, 1.9]	1.7 [0.7, 4.0]	2.9 [2.0, 4.0]	2.6 [1.9, 3.6]	3.9	0.0250	23.0	0.0190
	2008	1.0 [0.5, 2.0]	1.0 [0.5, 2.0]	1.2 [0.6, 2.7]	2.4 [1.6, 3.6]	4.6 [3.4, 6.3]	5.1	0.0000	41.2	0.0000
Malawi	2004	3.9 [2.5, 6.2]	3.1 [1.8, 5.2]	3.9 [2.4, 6.3]	6.4 [4.5, 8.9]	9.0 [6.2, 12.9]	5.5	0.0060	22.9	0.0010
	2010	3.0 [1.8, 4.9]	4.2 [2.9, 5.9]	5.4 [3.7, 7.8]	2.7 [1.7, 4.2]	6.6 [5.1, 8.7]	3.2	0.0030	11.8	0.0150
	2015	4.2 [2.9, 5.9]	3.3 [2.3, 4.8]	5.7 [4.3, 7.4]	7.9 [6.1, 10.0]	11.6 [9.5, 13.9]	10.7	0.0000	23.8	0.0000
Mali	2001	3.5 [2.0, 6.2]	4.8 [3.2, 7.1]	7.8 [5.8, 10.5]	9.0 [7.0, 11.5]	17.0 [12.8, 22.2]	15.2	0.0000	12.7	0.0050
	2006	5.0 [3.5, 7.1]	8.0 [6.2, 10.3]	7.7 [5.8, 10.3]	15.0 [8.5, 25.1]	17.7 [14.7, 21.2]	15.1	0.0000	21.6	0.0000
	2012	5.6 [4.0, 7.6]	4.3 [2.8, 6.7]	6.6 [4.7, 9.2]	9.9 [7.4, 12.9]	14.2 [12.1, 16.7]	14.5	0.0000	23.4	0.0000
	2018	11.2 [8.6, 14.5]	13.7 [11.1, 16.9]	16.1 [11.4, 17.3]	19.1 [15.9, 22.7]	19.8 [16.4, 23.7]	11.5	0.0000	12.9	0.0000
Niger	2006	1.2 [0.6, 2.3]	2.1 [1.1, 4.1]	2.6 [1.5, 4.3]	5.5 [3.8, 7.8]	11.3 [9.4, 13.6]	17.9	0.0000	43.5	0.0000
	2012	4.3 [2.4, 7.6]	5.4 [3.6, 8.0]	5.6 [3.9, 8.2]	6.1 [4.4, 8.5]	16.0 [13.4, 19.1]	13.1	0.0000	26.6	0.0000

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest wealth values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicate that the richest have a greater DBM prevalence than the poorest; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.2. (continued)

		Household wealth quintiles*								
Country	**Survey year**	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AFRICAN REGION										
Rwanda	2005	2.2 [1.4, 3.3]	2.3 [1.4, 3.6]	2.5 [1.6, 3.9]	2.0 [1.3, 3.3]	5.5 [4.2, 7.3]	3.4	0.0040	18.8	0.0050
	2010	2.2 [1.6, 3.2]	1.8 [1.2, 2.7]	2.3 [1.5, 3.4]	2.6 [1.6, 4.3]	4.2 [3.3, 5.5]	2.9	0.0020	15.1	0.0040
	2014	2.9 [2.0, 4.2]	3.4 [2.3, 4.9]	2.3 [1.5, 3.6]	2.8 [1.9, 4.2]	5.4 [4.2, 6.8]	2.5	0.0180	10.8	0.0210
	2019	0.9 [0.5, 1.8]	1.5 [0.8, 2.6]	2.1 [1.3, 3.4]	3.5 [2.4, 5.0]	5.4 [3.9, 7.5]	6.7	0.0000	33.9	0.0000
Senegal	2005	7.4 [5.3, 10.2]	8.3 [6.2, 11.1]	18.2 [14.7, 22.3]	18.2 [14.3, 22.9]	18.7 [14.8, 23.5]	15.8	0.0000	17.0	0.0000
	2010	7.0 [4.9, 9.9]	7.1 [5.4, 9.3]	11.5 [9.0, 14.5]	14.8 [11.5, 18.8]	19.1 [14.9, 24.2]	16.4	0.0000	20.5	0.0000
Sierra Leone	2008	12.9 [9.2, 17.8]	11.6 [8.5, 15.6]	11.5 [8.0, 16.1]	14.5 [11.6, 18.1]	19.8 [15.6, 24.8]	4.6	0.0850	9.2	0.0370
	2013	5.9 [4.4, 7.8]	6.2 [4.8, 8.1]	8.0 [6.3, 10.2]	9.8 [7.9, 12.1]	11.6 [8.9, 15.0]	7.7	0.0000	14.0	0.0000
	2019	8.9 [7.0, 11.4]	9.8 [7.8, 12.2]	12.6 [10.3, 15.4]	15.1 [12.8, 17.8]	16.9 [14.4, 19.6]	11.3	0.0000	13.8	0.0000
Tanzania	2004	4.2 [2.8, 6.2]	4.6 [3.5, 6.0]	5.4 [4.3, 7.0]	6.4 [5.2, 7.8]	18.0 [15.8, 20.6]	19.9	0.0000	32.9	0.0000
	2010	3.3 [2.3, 4.7]	4.2 [3.0, 5.9]	4.3 [3.0, 6.3]	9.9 [8.2, 11.9]	18.3 [15.7, 21.1]	22.7	0.0000	36.2	0.0000
	2015	5.6 [4.1, 7.7]	6.2 [5.0, 7.7]	7.9 [6.5, 9.6]	12.8 [10.9, 14.9]	21.4 [19.5, 23.5]	21.7	0.0000	28.3	0.0000

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest wealth values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicate that the richest have a greater DBM prevalence than the poorest; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.2. (continued)

		Household wealth quintiles*								
Country	**Survey year**	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AFRICAN REGION										
Uganda	2000	2.1 [1.2, 3.7]	1.4 [0.7, 3.0]	1.6 [0.7, 3.6]	4.4 [2.7, 6.9]	6.2 [4.6, 8.3]	9.5	0.0000	10.5	0.0440
	2006	1.7 [0.5, 5.6]	2.4 [1.2, 4.9]	5.1 [3.0, 8.7]	8.1 [5.5, 11.7]	11.0 [7.7, 15.4]	12.9	0.0000	31.9	0.0000
	2011	0.3 [0.0, 1.6]	1.2 [0.3, 3.5]	4.0 [2.0, 7.0]	4.8 [2.7, 7.9]	5.9 [4.0, 8.3]	8.6	0.0000	34.0	0.0000
	2016	3.2 [1.9, 5.1]	3.5 [2.3, 5.4]	5.3 [3.9, 7.3]	5.8 [4.1, 8.3]	11.5 [9.3, 14.1]	11.2	0.0000	26.6	0.0000
Zimbabwe	2005	4.7 [3.6, 6.1]	3.2 [2.4, 4.4]	6.1 [4.7, 7.8]	12.1 [10.1, 14.5]	15.1 [13.4, 16.9]	15.3	0.0000	27.2	0.0000
	2010	5.8 [4.5, 7.4]	6.9 [5.4, 8.8]	6.9 [5.5, 8.7]	8.7 [7.1, 10.5]	13.8 [11.5, 16.4]	10.0	0.0000	17.5	0.0000
	2015	5.0 [3.6, 6.8]	5.9 [4.5, 7.6]	10.0 [8.0, 12.3]	11.5 [9.6, 13.6]	14.3 [12.5, 16.2]	12.6	0.0000	19.1	0.0000
EASTERN MEDITERRANEAN REGION										
Egypt	2000	17.7 [15.7, 19.8]	19.6 [17.6, 21.9]	22.4 [20.4, 24.7]	22.2 [19.8, 24.8]	19.8 [16.9, 23.0]	3.4	0.0470	0.6	0.7380
	2005	27.0 [26.6, 27.4]	30.6 [30.5, 30.7]	29.6 [29.6, 29.6]	36.0 [33.3, 39.0]	36.5 [33.7, 39.4]	11.9	0.0000	4.2	0.0160
	2014	23.5 [20.6, 26.7]	21.8 [18.8, 25.1]	20.2[17.7, 23.0]	18.9 [16.4, 21.8]	23.0 [20.1, 26.3]	-1.8	0.4980	-1.6	0.4200

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest wealth values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicate that the richest have a greater DBM prevalence than the poorest; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.2. (continued)

		Household wealth quintiles*								
Country	**Survey year**	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**SII†**	**p-value**	**CIX‡**	**p-value**
EASTERN MEDITERRANEAN REGION										
Jordan	2002	21.0 [16.3, 26.6]	22.6 [17.3, 29.0]	15.8 [11.2, 21.6]	16.4 [11.1, 23.4]	16.9 [9.5, 28.2]	-4.0	0.3220	-1.8	0.6370
	2007	20.9 [20.6, 21.2]	21.2 [20.8, 21.5]	25.8 [25.7, 26.0]	25.7 [24.4, 27.1]	25.8 [21.8, 30.1]	6.5	0.0050	5.5	0.0300
	2012	24.7 [21.0, 28.8]	28.9 [25.0, 33.2]	27.4 [23.7, 31.5]	23.0 [19.2, 27.2]	24.4 [18.7, 31.2]	4.2	0.0400	-1.1	0.6560
	2017	34.9 [31.4, 38.5]	32.4 [28.4, 36.7]	27.1 [23.4, 31.0]	29.4 [25.1, 34.0]	31.2 [27.3, 35.4]	-5.1	0.1070	-2.5	0.1470
EUROPEAN REGION										
Albania	2008	9.6 [7.9, 11.8]	11.7 [9.8, 13.9]	10.0 [8.2, 12.1]	7.6 [6.2, 9.2]	6.7 [5.4, 8.4]	-2.2	0.0700	-8.9	0.0010
	2017	11.5 [10.2, 13.0]	13.6 [12.2, 15.2]	13.3 [11.8, 15.0]	13.2 [11.3, 15.4]	11.5 [9.5, 13.9]	-0.1	0.9280	0.1	0.9780
Armenia	2000	7.9 [5.8, 10.6]	8.2 [6.5, 10.2]	6.0 [4.1, 8.6]	4.3 [2.9, 6.5]	5.4 [3.8, 7.6]	-2.5	0.1420	-10.2	0.0080
	2005	8.1 [6.7, 9.9]	10.7 [8.9, 12.8]	11.9 [10.2, 14.0]	10.8 [8.0, 14.4]	11.2 [8.7, 14.4]	1.3	0.3950	4.7	0.1250
	2015	4.8 [3.6, 6.4]	6.3 [4.6, 8.5]	6.3 [4.6, 8.6]	6.3 [4.6, 8.5]	4.7 [3.2, 7.1]	-0.3	0.8520	-1.7	0.6740
AMERICAS REGION										
Bolivia	2003	14.4 [12.1, 17.1]	15.3 [13.4, 17.5]	20.0 [16.9, 23.5]	16.8 [14.5, 19.4]	10.2 [8.6, 12.1]	-5.5	0.0030	-6.1	0.0090
	2008	16.3 [13.0, 20.3]	19.6 [16.1, 23.6]	22.8 [19.4, 26.7]	19.4 [16.2, 23.1]	14.5 [12.3, 16.9]	-3.8	0.1340	-3.8	0.0890

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest wealth values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicate that the richest have a greater DBM prevalence than the poorest; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.2. (continued)

		Household wealth quintiles*								
Country	**Survey year**	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AMERICAS REGION										
Haiti	2000	5.3 [2.9, 9.6]	3.0 [1.3, 6.8]	14.2 [8.3, 23.3]	20.0 [17.0, 23.4]	26.2 [21.7, 31.2]	29.7	0.0000	0.3	0.9010
	2005	2.2 [1.2, 4.0]	5.4 [3.6, 7.8]	7.2 [5.6, 9.1]	10.4 [8.5, 12.6]	16.9 [13.8, 20.4]	17.3	0.0000	29.8	0.0000
	2012	3.9 [2.9, 5.3]	7.9 [6.0, 10.2]	12.4 [10.5, 14.5]	13.9 [11.8, 16.2]	20.8 [18.1, 23.8]	19.9	0.0000	24.2	0.0000
	2016	8.4 [6.6, 10.7]	9.6 [7.8, 11.8]	14.2 [12.1, 16.5]	19.1 [16.7, 21.8]	24.4 [22.0, 27.0]	21.8	0.0000	20.3	0.0000
Honduras	2005	4.5 [3.8, 5.3]	7.2 [6.3, 8.2]	9.5 [8.3, 10.8]	11.3 [9.9, 12.9]	10.4 [9.1, 12.0]	7.6	0.0000	10.9	0.0000
	2011	4.7 [4.0, 5.6]	6.5 [5.5, 7.6]	9.0 [7.7, 10.4]	11.2 [10.0, 12.5]	12.0 [10.5, 13.5]	9.4	0.0000	20.3	0.0000
Peru	2000	13.0 [11.4, 14.8]	16.5 [14.1, 19.3]	18.7 [16.5, 21.0]	15.8 [13.3, 18.7]	17.8 [14.7, 21.5]	3.7	0.1510	0.5	0.8040
	2007	10.1 [8.4, 12.2]	10.4 [9.2, 11.7]	13.4 [12.0, 14.9]	15.7 [13.7, 17.9]	13.2 [11.9, 14.7]	3.4	0.0000	4.7	0.0020
	2009	7.0 [5.9, 8.2]	9.8 [8.6, 11.1]	11.8 [10.5, 13.3]	12.2 [10.7, 13.8]	12.0 [10.5, 13.8]	3.9	0.0000	7.9	0.0000
	2010	8.8 [7.8, 10.0]	8.9 [7.8, 10.2]	11.2 [9.9, 12.7]	12.0 [10.5, 13.7]	10.3 [8.8, 12.0]	3.2	0.0000	4.3	0.0210
	2011	6.5 [5.4, 7.7]	9.0 [7.8, 10.4]	10.2 [8.9, 11.6]	10.1 [8.7, 11.7]	7.6 [6.4, 9.0]	2.9	0.0000	2.2	0.2560
	2012	9.1 [8.0, 10.4]	9.5 [8.4, 10.8]	9.2 [8.1, 10.4]	9.5 [8.4, 10.7]	9.6 [8.1, 11.2]	0.4	0.7360	0.5	0.7760

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest wealth values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicate that the richest have a greater DBM prevalence than the poorest; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.2. (continued)

		Household wealth quintiles*								
Country	**Survey year**	**Poorest (Q1)**	**Poorer (Q2)**	**Middle (Q3)**	**Richer (Q4)**	**Richest (Q5)**	**SII†**	**p-value**	**CIX‡**	**p-value**
SOUTHEAST ASIAN REGION										
India	2005	1.1 [0.9, 1.4]	2.3 [2.0, 2.6]	3.9 [3.6, 4.2]	7.9 [7.6, 8.3]	14.4 [14.0, 14.8]	20.3	0.0000	37.0	0.0000
	2015	3.3 [3.2, 3.5]	6.4 [6.2, 6.7]	10.5 [10.2, 10.8]	15.4 [15.0, 15.8]	18.9 [18.4, 19.3]	20.6	0.0000	28.4	0.0000
Nepal	2006	0.5 [0.2, 1.4]	0.3 [0.1, 0.8]	0.9 [0.5, 1.7]	2.7 [1.8, 4.2]	5.8 [4.9, 6.8]	9.2	0.0000	51.5	0.0000
	2011	0.5 [0.2, 1.3]	1.3 [0.7, 2.5]	1.9 [1.0, 3.5]	3.8 [2.6, 5.5]	8.2 [6.4, 10.4]	11.9	0.0000	41.5	0.0000
	2016	3.2 [2.1, 4.9]	5.3 [4.0, 6.9]	6.0 [4.4, 8.1]	8.6 [6.5, 11.2]	15.2 [12.7, 18.0]	14.4	0.0000	26.2	0.0000
Timor-Leste	2009	0.3 [0.0, 2.0]	0.1 [0.0, 0.9]	1.1 [0.5, 2.7]	1.4 [0.6, 3.5]	3.7 [2.0, 6.7]	3.3	0.0020	48.6	0.0000
	2016	0.2 [0.0, 1.1]	0.9 [0.3, 2.7]	1.0 [0.4, 2.5]	4.6 [2.6, 7.8]	4.9 [3.2, 7.4]	7.4	0.0000	42.8	0.0000
WESTERN PACIFIC REGION										
Cambodia	2000	1.6 [0.7, 3.7]	3.2 [2.3, 4.5]	1.6 [0.8, 3.3]	6.7 [4.7, 9.3]	7.0 [5.1, 9.6]	6.9	0.0000	6.4	0.2650
	2005	2.0 [1.3, 3.1]	2.3 [1.5, 3.6]	2.6 [1.8, 3.8]	5.3 [4.1, 6.9]	5.3 [4.2, 6.7]	6.4	0.0000	20.0	0.0000
	2010	2.7 [1.8, 4.1]	4.7 [3.3, 6.5]	4.0 [2.9, 5.4]	5.1 [3.4, 7.5]	5.4 [4.1, 7.1]	3.5	0.0000	8.7	0.0350
	2014	5.2 [4.0, 6.7]	7.9 [6.3, 9.9]	7.6 [6.2, 9.4]	8.6 [7.1, 10.4]	8.6 [7.4, 10.1]	3.7	0.0010	7.3	0.0030

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest wealth values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicate that the richest have a greater DBM prevalence than the poorest; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.3. Trends in the prevalence of concurrent overweight/obesity and anaemia among adult women (20-49 years old) by education level.

		Education level*						
Country	**Survey year**	**None (E1)**	**Primary (E2)**	**Secondary+ (E3)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AFRICAN REGION								
Benin	2001	9.3 [7.8, 11.2]	20.6 [17.3, 24.4]	22.8 [18.5, 27.7]	21.6	0.0000	25.1	0.3219
	2011	11.2 [9.9, 12.7]	17.6 [14.3, 21.4]	13.7 [10.8, 17.3]	7.9	0.0000	19.5	0.2453
	2017	13.8 [12.5, 15.3]	22.2 [19.2, 25.5]	16.0 [13.8, 18.5]	8.5	0.0000	8.8	0.1320
Burkina Faso	2003	3.1 [2.4, 3.9]	11.5 [8.0, 15.9]	10.8 [6.7, 16.2]	12.5	0.0000	30.2	0.4219
	2010	4.0 [3.4, 4.7]	7.8 [5.9, 10.2]	11.3 [9.0, 14.0]	8.6	0.0000	13.7	0.2156
Burundi	2010	0.8 [0.5, 1.4]	1.7 [0.9, 3.0]	2.3 [1.3, 4.3]	2.1	0.0300	29.7	0.4580
	2016	1.3 [0.9, 18.4]	2.2 [1.6, 3.0]	4.0 [2.9, 5.6]	3.0	0.0000	22.1	0.3296
Cameroon	2004	3.3 [2.3, 4.7]	15.2 [13.0, 17.6]	19.0 [17.2, 21.0]	19.4	0.0000	22.5	0.2770
	2011	5.8 [4.3, 7.8]	11.4 [10.0, 12.9]	18.7 [17.0, 20.6]	17.6	0.0000	18.7	0.2292
	2018	6.4 [4.7, 8.7]	16.6 [14.1, 19.5]	19.9 [17.8, 22.3]	14.3	0.0000	16.4	0.2151
Congo	2005	11.7 [6.5, 19.9]	14.7 [11.1, 19.1]	15.4 [13.0, 18.2]	4.9	0.1340	-1.4	0.0518
	2011	10.4 [5.4, 19.0]	12.3 [9.6, 15.6]	17.7 [15.0, 20.8]	15.5	0.0000	15.7	0.2226
DRC	2007	3.2 [2.0, 4.8]	4.7 [3.5, 6.1]	9.3 [7.7, 11.1]	10.0	0.0000	26.0	0.3672
	2013	2.6 [1.5, 4.4]	4.1 [3.2, 5.2]	8.5 [7.1, 10.2]	9.6	0.0000	19.5	0.2641

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. Estimates for certain categories are missing due to sample size <25.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest education values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicates that the most educated have a greater DBM prevalence than the least educated; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.3. (continued)

		Education level*						
Country	**Survey year**	**None (E1)**	**Primary (E2)**	**Secondary+ (E3)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AFRICAN REGION								
Ethiopia	2005	0.7 [0.4, 1.3]	1.0 [0.6, 1.7]	2.9 [1.7, 5.0]	2.3	0.0030	23.9	0.5262
	2011	0.6 [0.4, 0.9]	0.7 [0.4, 1.3]	1.5 [0.9, 2.6]	1.8	0.0000	17.1	0.3619
	2016	1.0 [0.7, 1.4]	2.1 [1.3, 3.3]	3.4 [2.2, 5.2]	2.4	0.0000	28.3	0.4016
Gambia	2013	13.7 [11.7, 16.0]	13.3 [9.3, 18.6]	13.7 [10.9, 17.1]	0.9	0.7230	0.2	0.0772
	2019	19.0 [17.0, 21.3]	16.6 [12.9, 21.1]	14.2 [12.1, 16.7]	-10.5	0.0000	-6.8	0.0193
Ghana	2003	6.5 [5.1, 8.3]	11.1 [9.0, 13.8]	12.4 [10.8, 14.3]	11.4	0.0000	12.4	0.1864
	2008	11.2 [9.1, 13.7]	20.6 [17.5, 24.2]	20.9 [18.7, 23.2]	18.2	0.0000	2.2	0.0680
	2014	11.3 [9.0, 14.0]	16.2 [12.9, 20.1]	19.3 [16.9, 22.0]	11.3	0.0000	12.0	0.1715
Guinea	2005	6.4 [5.2, 7.8]	11.9 [8.2, 17.0]	15.7 [11.0, 21.9]	11.1	0.0000	8.7	0.1889
	2012	7.7 [6.4, 9.2]	9.4 [6.6, 13.3]	13.6 [10.9, 16.8]	7.4	0.0010	7.6	0.1516
	2018	12.1 [10.6, 13.7]	14.3 [10.3, 19.5]	14.6 [11.7, 18.0]	4.3	0.0860	3.1	0.0894
Lesotho	2004	16.2 [15.1, 17.2]	12.3 [10.4, 14.5]	15.5 [12.7, 18.7]	5.5	0.0720	7.7	0.1590
	2009	17.3 [9.6, 29.4]	8.9 [7.3, 10.7]	13.1 [10.8, 15.8]	5.5	0.0220	8.9	0.1663
	2014	17.2 [4.1, 50.2]	9.7 [7.8, 12.0]	14.4 [12.1, 17.0]	11.5	0.0190	6.0	0.1480

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. Estimates for certain categories are missing due to sample size <25.
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‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicates that the most educated have a greater DBM prevalence than the least educated; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.3. (continued)

		Education level*						
Country	**Survey year**	**None (E1)**	**Primary (E2)**	**Secondary+ (E3)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AFRICAN REGION								
Madagascar	2003	2.2 [1.0, 4.6]	2.0 [1.2, 3.3]	2.1 [1.2, 3.8]	0.7	0.6850	17.2	0.3745
	2008	1.7 [1.0, 2.9]	1.6 [1.1, 2.3]	3.6 [2.8, 4.8]	4.0	0.0000	27.3	0.3880
Malawi	2004	3.8 [2.5, 5.7]	5.7 [4.3, 7.4]	6.3 [4.2, 9.5]	1.2	0.5570	12.7	0.2544
	2010	2.9 [1.6, 5.2]	4.5 [3.7, 5.5]	6.1 [4.4, 8.6]	2.4	0.0320	13.0	0.2342
	2015	7.4 [5.3, 10.1]	5.7 [4.8, 6.8]	8.6 [6.9, 10.7]	5.4	0.0000	4.6	0.1257
Mali	2001	7.4 [5.9, 9.4]	15.3 [12.3, 18.8]	13.0 [9.9, 16.9]	10.9	0.0000	20.0	0.3187
	2006	10.8 [7.8, 14.9]	11.5 [9.2, 14.4]	14.2 [10.7, 18.6]	7.7	0.0030	-7.3	0.1316
	2012	7.7 [6.6, 8.9]	12.4 [9.0, 16.9]	9.2 [6.8, 12.4]	6.5	0.0030	7.5	0.1457
	2018	15.5 [13.8, 17.3]	18.6 [14.6, 23.3]	15.2 [11.7, 19.5]	0.0	0.9950	5.3	0.1084
Niger	2006	4.0 [3.1, 5.2]	7.5 [5.5, 10.3]	11.0 [7.6, 15.6]	9.5	0.0000	19.0	0.2985
	2012	6.9 [5.7, 8.2]	12.0 [8.5, 16.6]	12.8 [9.2, 17.6]	10.3	0.0000	12.1	0.2056

DRC, Democratic Republic of the Congo
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‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicates that the most educated have a greater DBM prevalence than the least educated; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.3. (continued)

		Education level*						
Country	**Survey year**	**None (E1)**	**Primary (E2)**	**Secondary+ (E3)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AFRICAN REGION								
Rwanda	2005	3.2 [2.2, 4.7]	2.3 [1.7, 3.0]	5.2 [3.6, 7.4]	1.4	0.2850	6.3	0.1981
	2010	3.0 [2.1, 4.4]	2.3 [1.8, 2.9]	4.3 [3.1, 5.8]	1.8	0.1130	5.6	0.1589
	2014	2.2 [1.4, 3.6]	3.4 [2.8, 4.1]	4.6 [3.4, 6.1]	3.7	0.0020	9.7	0.1800
	2019	1.5 [0.8, 2.8]	2.4 [1.9, 3.1]	4.4 [3.1, 6.1]	3.9	0.0000	17.9	0.3043
Senegal	2005	13.2 [11.3, 15.4]	17.6 [13.9, 21.9]	18.3 [12.5, 25.9]	7.3	0.0060	9.3	0.1708
	2010	11.3 [9.7, 13.1]	16.1 [12.1, 21.1]	14.0 [10.4, 18.5]	5.5	0.0090	8.1	0.1436
Sierra Leone	2008	12.8 [10.7, 15.3]	18.0 [13.5, 23.6]	17.5 [13.5, 22.4]	6.5	0.0300	6.5	0.1472
	2013	7.6 [6.5, 8.9]	10.2 [7.7, 13.4]	10.0 [7.4, 13.4]	2.3	0.1630	6.2	0.1351
	2019	13.5 [12.0, 15.0]	10.3 [7.9, 13.2]	13.1 [11.2, 15.3]	1.2	0.5220	0.2	0.0518
Tanzania	2004	7.9 [5.9, 10.4]	7.6 [6.5, 8.7]	17.0 [14.3, 20.1]	10.3	0.0000	5.4	0.1364
	2010	5.3 [3.6, 7.7]	8.3 [7.2, 9.5]	16.2 [12.8, 20.3]	13.6	0.0000	12.3	0.1953
	2015	8.8 [7.2, 10.7]	11.1 [10.0, 12.3]	17.3 [15.4, 19.3]	11.8	0.0000	7.6	0.1183

DRC, Democratic Republic of the Congo
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‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicates that the most educated have a greater DBM prevalence than the least educated; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.3. (continued)

		Education level*						
Country	**Survey year**	**None (E1)**	**Primary (E2)**	**Secondary+ (E3)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AFRICAN REGION								
Uganda	2000	2.9 [2.0, 4.1]	3.0 [2.3, 4.0]	5.5 [3.9, 7.6]	5.1	0.0000	12.4	0.2402
	2006	3.6 [2.0, 6.6]	6.7 [5.2, 8.6]	7.6 [5.0, 11.3]	5.8	0.0040	6.7	0.1767
	2011	2.1 [0.8, 4.5]	3.4 [2.3, 4.8]	4.7 [3.0, 6.9]	3.3	0.0600	0.5	0.1927
	2016	5.6 [3.5, 8.8]	5.1 [4.1, 6.3]	9.0 [7.1, 11.4]	4.4	0.0050	10.1	0.2038
Zimbabwe	2005	7.4 [5.6, 9.8]	8.0 [6.9, 9.3]	9.6 [8.5, 10.8]	3.6	0.0230	4.8	0.1066
	2010	10.3 [6.0, 17.0]	7.6 [6.4, 9.1]	9.2 [8.2, 10.4]	3.2	0.0530	1.7	0.0764
	2015	2.3 [0.6, 8.3]	8.4 [7.2, 9.9]	10.6 [9.5, 11.8]	5.3	0.0040	2.9	0.0809
EASTERN MEDITERRANEAN REGION								
Egypt	2000	19.4 [17.6, 21.3]	21.8 [19.5, 24.3]	20.9 [18.7, 23.2]	4.0	0.0330	-1.2	0.0235
	2005	30.8 [30.6, 31.1]	33.2 [30.1, 36.4]	33.0 [31.1, 34.8]	2.8	0.2500	-0.8	0.0225
	2014	20.2 [17.7, 23.0]	21.5 [17.8, 25.7]	21.8 [20.2, 23.6]	-0.2	0.9280	0.6	0.0398

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. Estimates for certain categories are missing due to sample size <25.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest education values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicates that the most educated have a greater DBM prevalence than the least educated; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.3. (continued)

Country	Survey year	None (E1)	Primary (E2)	Secondary+ (E3)	SII†	p-value	CIX‡	p-value
		Education level*						
EASTERN MEDITERRANEAN REGION								
Jordan	2002	23.9 [17.6, 31.6]	28.2 [21.9, 35.5]	17.5 [14.9, 20.5]	-10.4	0.0210	-7.1	0.0149
	2007	26.8 [26.3, 27.2]	31.1 [29.8, 32.5]	23.4 [23.3, 23.6]	-12.8	0.0000	-7.1	0.0309
	2012	22.4 [14.1, 33.5]	29.4 [21.9, 38.3]	25.5 [23.7, 27.5]	-0.5	0.8820	4.2	0.0849
	2017	31.6 [22.4, 42.6]	36.4 [29.5, 43.9]	30.5 [28.6, 32.5]	-3.8	0.3110	-0.3	0.0313
EUROPEAN REGION								
Albania	2008	-	9.9 [8.7, 11.3]	8.0 [6.8, 9.4]	-	-	-	-
	2017	14.3 [7.4, 25.6]	14.0 [12.8, 15.3]	11.5 [10.4, 12.6]	-4.5	0.0000	-	-
Armenia	2000	-	-	5.1 [4.4, 5.9]	-	-	-	-
	2005	-	-	10.6 [9.7, 11.5]	-	-	-	-
	2015	-	6.2 [3.4, 11.1]	5.7 [4.7, 6.8]	-	-	-	-
AMERICAS REGION								
Bolivia	2003	15.4 [13.3, 17.8]	16.8 [14.9, 19.0]	13.4 [11.7, 15.3]	-4.9	0.0210	-4.9	0.0033
	2008	21.4 [14.8, 29.9]	21.2 [19.0, 23.6]	15.6 [13.7, 17.7]	-9.6	0.0000	-8.6	0.0389

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. Estimates for certain categories are missing due to sample size <25.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest education values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicates that the most educated have a greater DBM prevalence than the least educated; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.3. (continued)

		Education level*						
Country	**Survey year**	**None (E1)**	**Primary (E2)**	**Secondary+ (E3)**	**SII†**	**p-value**	**CIX‡**	**p-value**
AMERICAS REGION								
Haiti	2000	11.4 [9.7, 13.4]	12.2 [8.7, 16.8]	15.4 [11.5, 20.5]	9.0	0.0000	0.9	0.0889
	2005	7.1 [5.6, 8.9]	9.6 [7.6, 12.1]	11.6 [9.7, 13.8]	6.6	0.0000	9.1	0.1631
	2012	9.2 [7.4, 11.5]	11.4 [9.9, 13.2]	15.8 [14.1, 17.7]	10.7	0.0000	10.4	0.1537
	2016	12.5 [10.3, 15.1]	16.8 [14.6, 19.1]	17.7 [16.1, 19.5]	7.6	0.0000	4.9	0.0900
Honduras	2005	8.0 [6.7, 9.5]	9.3 [8.5, 10.2]	8.6 [7.6, 9.7]	1.0	0.3130	-3.8	0.0023
	2011	8.6 [6.6, 11.0]	9.0 [8.3, 9.9]	9.2 [8.2, 10.1]	2.7	0.0030	4.9	0.0900
Peru	2000	11.6 [9.4, 14.2]	18.7 [16.8, 20.7]	14.5 [13.1, 16.0]	-3.1	0.1240	-1.3	0.0227
	2007	13.1 [10.1, 16.8]	13.7 [12.6, 15.0]	12.8 [11.9, 13.8]	-1.9	0.0580	-0.9	0.0212
	2009	11.4 [8.9, 14.5]	10.3 [9.2, 11.4]	11.0 [10.2, 12.0]	0.2	0.8400	1.1	0.0447
	2010	9.5 [6.7, 13.3]	10.9 [9.8, 12.1]	10.3 [9.4, 11.1]	-0.6	0.5460	0.3	0.0424
	2011	7.4 [5.1, 10.7]	10.0 [9.0, 11.1]	8.4 [7.8, 9.2]	-1.1	0.2190	0.3	0.0433
	2012	10.3 [7.9, 13.4]	9.8 [8.7, 10.9]	9.2 [8.5, 10.0]	-0.7	0.4530	-1.3	0.0227

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. Estimates for certain categories are missing due to sample size <25.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest education values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicates that the most educated have a greater DBM prevalence than the least educated; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.3. (continued)

		Education level*						
Country	**Survey year**	**None (E1)**	**Primary (E2)**	**Secondary+ (E3)**	**SII†**	**p-value**	**CIX‡**	**p-value**
SOUTHEAST ASIAN REGION								
India	2005	4.5 [4.2, 4.7]	7.2 [6.7, 7.6]	10.3 [10.0, 10.6]	10.8	0.0000	18.6	0.1986
	2015	8.4 [8.2, 8.6]	11.4 [11.0, 11.8]	13.2 [13.0, 13.5]	7.1	0.0000	10.9	0.1175
Nepal	2006	1.8 [1.3, 2.4]	2.3 [1.1, 4.7]	3.4 [2.6, 4.3]	3.1	0.0000	13.9	0.2397
	2011	2.3 [1.7, 3.3]	3.3 [2.1, 5.3]	5.1 [3.8, 6.7]	5.0	0.0000	13.0	0.2461
	2016	5.8 [4.6, 7.2]	8.0 [5.9, 10.8]	10.3 [8.7, 12.1]	6.0	0.0000	8.8	0.1602
Timor-Leste	2009	1.3 [0.7, 2.4]	1.1 [0.5, 2.5]	1.8 [0.9, 3.7]	-0.3	0.7190	8.1	0.3421
	2016	1.2 [0.5, 2.6]	3.2 [1.7, 5.8]	2.9 [2.2, 4.0]	2.6	0.0260	12.1	0.2325
WESTERN PACIFIC REGION								
Cambodia	2000	3.9 [2.7, 5.6]	3.7 [2.8, 4.9]	2.2 [1.1, 4.4]	-0.3	0.8410	-16.1	0.0312
	2005	3.4 [2.6, 4.5]	3.9 [3.3, 4.6]	3.1 [2.2, 4.3]	-0.0	0.9160	-3.2	0.0578
	2010	4.8 [3.5, 6.5]	4.6 [3.8, 5.6]	3.9 [3.0, 5.1]	-1.4	0.1340	-7.8	0.0013
	2014	8.9 [7.2, 10.9]	8.7 [7.6, 9.9]	5.6 [4.7, 6.6]	-3.2	0.0020	-11.2	0.0602

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. Estimates for certain categories are missing due to sample size <25.
† The SII represents the absolute difference in the fitted value of concurrent overweight/obesity and anaemia between the highest and lowest education values. A positive value depicts that the DBM burden is concentrated among the richest groups; whereas a negative value represents the opposite. Statistical significance= p-value <0.05.
‡ The CIX represents the extent to which the DBM is concentrated among the disadvantaged or the advantaged. A positive value indicates that the most educated have a greater DBM prevalence than the least educated; whereas a negative value depicts the opposite. Statistical significance= p-value <0.05.

Table 8.4. Trends in the prevalence of concurrent overweight/obesity and anaemia among adult women (20-49 years old) by area of residence.

		Area of residence*					
Country *(capital)*	**Survey year**	**Capital**	**Other urban**	**Total urban**	**Rural**	**Gap**	**p-value**
AFRICAN REGION							
Benin	2001	27.2 [22.9, 32.1]	16.2 [12.6, 20.7]	20.3 [17.5, 23.5]	8.3 [6.7, 10.1]	12.0	0.0000
(Cotonou)	2011	17.9 [13.6, 23.2]	15.0 [12.5, 18.0]	15.9 [13.7, 18.5]	10.1 [8.8, 11.6]	5.8	0.0000
	2017	29.5 [24.4, 35.1]	19.7 [17.7, 21.9]	21.2 [19.3, 23.2]	11.6 [10.3, 13.1]	9.6	0.0000
Burkina Faso	2003	15.7 [9.9, 23.3]	13.9 [10.8, 17.3]	14.3 [11.5, 17.3]	1.8 [1.3, 2.5]	12.5	0.0000
(Ouagadougou)	2010	13.4 [10.8, 16.5]	9.7 [8.0, 11.8]	11.5 [10.0, 13.2]	3.0 [2.5, 3.7]	8.5	0.0000
Burundi	2010	5.0 [3.1, 8.0]	4.0 [1.6, 9.6]	4.7 [3.1, 7.0]	0.9 [0.5, 1.5]	3.8	0.0000
(Bujumbura)	2016	4.3 [2.0, 8.8]	3.9 [2.4, 6.2]	4.1 [2.5, 6.6]	1.9 [1.5, 2.3]	2.2	0.0027
Cameroon	2004	32.9 [28.0, 38.2]	16.0 [14.2, 18.0]	19.7 [17.8, 21.6]	7.0 [5.8, 8.5]	12.7	0.0000
(Douala)	2011	26.0 [21.9, 30.1]	14.5 [13.0, 16.2]	17.2 [15.7, 18.8]	8.5 [7.3, 10.0]	8.7	0.0000
	2018	38.6 [33.9, 43.5]	16.1 [14.2, 18.2]	21.5 [19.3, 23.8]	8.9 [7.6, 10.5]	12.6	0.0000
Congo	2005	16.9 [13.2, 21.3]	16.4 [13.4, 20.0]	16.7 [14.2, 19.6]	12.6 [9.4, 16.6]	4.1	0.0785
(Brazzaville)	2011	17.9 [13.4, 23.6]	21.2 [17.7, 25.3]	19.6 [16.7, 22.9]	8.2 [7.1, 9.5]	11.4	0.0000
DRC	2007	15.9 [12.7, 19.5]	6.9 [5.3, 8.7]	9.9 [8.4, 11.6]	2.8 [2.1, 3.8]	7.1	0.0000
(Kinshasa)	2013	17.8 [14.7, 21.3]	6.6 [5.2, 8.4]	10.3 [8.7, 12.2]	3.1 [2.3, 4.1]	7.2	0.0000

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. The estimate for women living in the capital and other urban areas is missing for Nepal 2011, as the survey does not identify whether urban citizens are living in the capital city or elsewhere.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural). Statistical significance= p-value <0.05.

Table 8.4. (continued)

		Area of residence*					
Country *(capital)*	**Survey year**	**Capital**	**Other urban**	**Total urban**	**Rural**	**Gap†**	**p-value**
AFRICAN REGION							
Ethiopia	2005	1.3 [0.5, 3.3]	2.8 [1.8, 4.4]	2.4 [1.6, 3.5]	0.7 [0.4, 1.3]	1.7	0.0002
(Addis Ababa)	2011	2.4 [1.6, 3.6]	1.1 [0.6, 2.0]	1.4 [1.0, 2.1]	0.5 [0.3, 0.9]	0.9	0.0031
	2016	5.0 [3.6, 6.8]	3.5 [2.4, 5.2]	3.9 [2.9, 5.2]	1.0 [0.7, 1.4]	2.9	0.0000
Gambia	2013	22.7 [17.3, 29.2]	15.0 [12.7, 17.6]	15.3 [13.1, 17.8]	11.6 [9.8, 13.6]	3.7	0.0145
(Banjul)	2019	24.2 [18.1, 31.6]	16.6 [14.6, 18.8]	16.7 [14.8, 18.9]	15.8 [13.8, 17.9]	0.9	0.5069
Ghana	2003	20.4 [16.5, 25.1]	11.0 [8.9, 13.5]	14.0 [12.0, 16.2]	7.1 [5.9, 8.5]	6.9	0.0000
(Accra)	2008	25.0 [20.3, 30.3]	24.0 [20.8, 27.2]	24.2 [21.7, 27.0]	13.0 [11.5, 14.7]	11.2	0.0000
	2014	27.3 [21.6, 33.9]	16.7 [14.1, 19.7]	20.5 [17.8, 23.5]	12.6 [10.6, 15.0]	7.9	0.0000
Guinea	2005	21.7 [16.6, 27.7]	10.2 [6.4, 15.7]	15.2 [12.2, 18.9]	4.5 [3.7, 5.6]	10.7	0.0000
(Conakry)	2012	14.9 [12.4, 18.0]	14.0 [10.8, 17.9]	14.5 [12.5, 16.9]	5.9 [4.7, 7.4]	8.6	0.0000
	2018	18.6 [15.1,22.9]	15.7 [12.4, 19.6]	17.1 [14.6, 19.9]	10.3 [8.8, 11.9]	6.8	0.0000
Lesotho	2004	13.3 [7.6, 22.1]	17.8 [14.6, 21.6]	15.6 [12.3, 19.6]	13.0 [11.2, 15.1]	2.6	0.1984
(Maseru)	2009	9.6 [6.4, 14.4]	14.5 [10.7, 19.4]	12.4 [9.7, 15.6]	10.4 [8.7, 12.4]	2.0	0.2505
	2014	15.6 [9.8, 23.8]	12.9 [10.5, 15.9]	14.2 [11.1, 17.8]	11.4 [9.8, 13.2]	2.8	0.1307

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. The estimate for women living in the capital and other urban areas is missing for Nepal 2011, as the survey does not identify whether urban citizens are living in the capital city or elsewhere.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural). Statistical significance= p-value <0.05.

Table 8.4. (continued)

		Area of residence*					
Country *(capital)*	**Survey year**	**Capital**	**Other urban**	**Total urban**	**Rural**	**Gap†**	**p-value**
			AFRICAN REGION				
Madagascar	2003	3.1 [1.9, 5.1]	4.2 [2.7, 6.4]	3.8 [2.7, 5.2]	1.6 [1.0, 2.4]	2.2	0.0011
(Antananarivo)	2008	2.2 [1.1, 4.7]	5.6 [4.1, 7.7]	4.5 [3.3, 6.0]	1.7 [1.3, 2.3]	2.8	0.0000
Malawi	2004	11.0 [2.9, 33.9]	5.5 [2.9, 10.4]	7.0 [3.8, 12.5]	4.9 [3.8, 6.3]	2.1	0.2900
(Lilongwe)	2010	7.7 [4.8, 12.2]	5.4 [3.5, 8.3]	6.5 [4.7, 8.8]	4.0 [3.3, 4.8]	2.5	0.0105
	2015	11.2 [7.9, 15.5]	11.7 [9.2, 14.8]	11.5 [9.4, 13.9]	5.7 [4.9, 6.6]	5.8	0.0000
Mali	2001	16.2 [13.0, 20.0]	16.0 [9.7, 25.4]	16.1 [12.6, 20.5]	5.9 [4.5, 7.8]	10.2	0.0000
(Bamako)	2006	17.2 [14.1, 20.7]	20.7 [12.7, 31.7]	19.3 [13.9, 26.2]	6.9 [5.5, 8.7]	12.4	0.0000
	2012	19.2 [15.7, 23.3]	11.1 [8.9, 13.9]	15.1 [13.1, 17.5]	6.2 [5.2, 7.3]	8.9	0.0000
	2018	21.6 [17.2, 26.8]	17.7 [13.2, 23.3]	20.2 [16.9, 24.0]	14.3 [12.7, 16.1]	5.9	0.0018
Niger	2006	15.0 [11.2, 19.8]	10.5 [7.5, 14.6]	12.6 [10.2, 15.4]	2.8 [2.0, 4.0]	9.8	0.0000
(Niamey)	2012	21.9 [18.1, 26.3]	14.0 [10.5, 18.4]	17.4 [14.7, 20.5]	5.5 [4.4, 6.8]	11.9	0.0000

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. The estimate for women living in the capital and other urban areas is missing for Nepal 2011, as the survey does not identify whether urban citizens are living in the capital city or elsewhere.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural). Statistical significance= p-value <0.05.

Table 8.4. (continued)

		Area of residence*					
Country *(capital)*	**Survey year**	**Capital**	**Other urban**	**Total urban**	**Rural**	**Gap†**	**p-value**
			AFRICAN REGION				
Rwanda	2005	6.1 [3.8, 9.6]	3.8 [1.9, 7.1]	4.8 [3.3, 6.9]	2.5 [1.9, 3.2]	2.3	0.0042
(Kigali)	2010	4.7 [3.3, 6.8]	3.7 [3.7, 3.8]	4.4 [3.4, 5.6]	2.4 [1.9, 3.0]	2.0	0.0024
	2014	5.3 [3.8, 7.3]	6.1 [4.3, 8.5]	5.6 [4.5, 7.1]	2.9 [2.4, 3.5]	2.7	0.0000
	2019	6.3 [4.0, 9.8]	3.5 [2.3, 5.4]	5.1 [3.6, 7.1]	2.2 [1.8, 2.8]	2.9	0.0001
Senegal	2005	20.8 [16.1, 26.3]	19.0 [16.1, 22.2]	20.0 [17.1, 23.3]	10.0 [8.4, 11.9]	10.0	0.0000
(Dakar)	2010	21.2 [16.3, 27.2]	13.2 [11.4, 15.2]	17.6 [14.7, 21.0]	7.9 [6.6, 9.5]	9.7	0.0000
Sierra Leone	2008	20.4 [15.8, 26.0]	17.7 [13.6, 22.7]	19.2 [16.0, 23.0]	11.7 [9.5, 14.2]	7.5	0.0003
(Freetown)	2013	10.2 [7.0, 14.5]	13.0 [10.7, 15.7]	11.5 [9.4, 14.1]	6.8 [5.8, 8.0]	4.7	0.0001
	2019	16.7 [14.3, 19.4]	13.5 [11.1, 16.3]	15.2 [13.4, 17.1]	11.1 [9.8, 12.6]	4.1	0.0004
Tanzania	2004	21.2 [16.3, 27.1]	12.8 [10.5, 15.5]	15.4 [13.3, 17.8]	5.6 [4.6, 6.7]	9.8	0.0000
(Dar es Salaam)	2010	24.8 [19.6, 30.8]	11.5 [9.3, 14.2]	15.1 [12.9, 17.7]	5.9 [5.0, 7.0]	9.2	0.0000
	2015	25.1 [21.4, 29.2]	15.0 [13.1, 17.0]	18.2 [16.4, 20.2]	8.4 [7.5, 9.5]	9.8	0.0000

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. The estimate for women living in the capital and other urban areas is missing for Nepal 2011, as the survey does not identify whether urban citizens are living in the capital city or elsewhere.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural). Statistical significance= p-value <0.05.

Table 8.4. (continued)

		Area of residence*					
Country *(capital)*	**Survey year**	**Capital**	**Other urban**	**Total urban**	**Rural**	**Gap†**	**p-value**
AFRICAN REGION							
Uganda	2000	6.8 [4.4, 10.3]	6.2 [4.2, 9.0]	6.6 [4.8, 8.9]	2.8 [2.2, 3.6]	3.8	0.0000
(Kampala)	2006	10.2 [5.8, 17.1]	4.8 [2.0, 11.1]	7.5 [4.7, 11.8]	5.8 [4.6, 7.4]	1.7	0.3203
	2011	6.3 [3.5, 10.4]	5.1 [3.0, 8.2]	5.6 [3.8, 7.9]	2.6 [1.8, 3.7]	3.0	0.0020
	2016	12.2 [8.3, 17.6]	8.1 [6.0, 10.9]	9.0 [7.1, 11.4]	5.5 [4.4, 6.7]	3.5	0.0018
Zimbabwe	2005	12.1 [9.9, 14.8]	14.8 [13.0, 16.9]	13.7 [12.2, 15.2]	6.0 [5.1, 7.2]	7.7	0.0000
(Harare)	2010	10.1 [7.5, 13.5]	12.8 [10.7, 15.2]	11.5 [9.7, 13.5]	7.2 [6.3, 8.2]	4.3	0.0000
	2015	13.8 [10.9, 17.3]	12.9 [11.3, 14.7]	13.3 [11.7, 15.1]	7.7 [6.6, 8.9]	5.6	0.0000
EASTERN MEDITERRANEAN REGION							
Egypt	2000	24.9 [20.8, 29.5]	19.8 [17.7, 22.1]	22.1 [19.9, 24.5]	19.0 [17.5, 20.5]	3.1	0.0273
(Cairo)	2005	34.6 [31.7, 37.7]	36.4 [33.8, 39.0]	35.6 [33.7, 37.6]	29.9 [28.2, 31.5]	5.7	0.0000
	2014	18.6 [14.5, 23.5]	23.7 [21.2, 26.4]	21.9 [19.7, 24.3]	21.1 [19.3, 22.9]	0.8	0.5735

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. The estimate for women living in the capital and other urban areas is missing for Nepal 2011, as the survey does not identify whether urban citizens are living in the capital city or elsewhere.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural). Statistical significance= p-value <0.05.

Table 8.4. (continued)

		Area of residence*					
Country *(capital)*	**Survey year**	**Capital**	**Other urban**	**Total urban**	**Rural**	**Gap†**	**p-value**
EASTERN MEDITERRANEAN REGION							
Jordan	2002	18.2 [14.6, 22.5]	22.9 [18.4, 28.2]	19.5 [16.5, 22.9]	18.4 [14.9, 22.6]	1.1	0.6617
(Amman)	2007	22.9 [20.5, 25.3]	23.6 [23.2, 24.1]	24.5 [24.3, 24.6]	23.0 [21.8, 24.2]	1.5	0.0034
	2012	23.8 [21.0, 26.9]	29.5 [26.8, 32.3]	25.6 [23.5, 27.8]	26.7 [23.8, 29.9]	-1.1	0.5412
	2017	30.5 [26.8, 34.3]	30.7 [28.8, 32.8]	30.6 [28.6, 32.7]	33.3 [29.6, 37.2]	-2.7	0.2102
EUROPEAN REGION							
Albania	2008	4.2 [2.9, 6.0]	8.2 [6.6, 10.1]	6.7 [5.6, 8.1]	11.1 [9.8, 12.6]	-4.4	0.0000
(Tirana)	2017	13.8 [11.5, 16.6]	12.6 [11.5, 13.8]	13.1 [11.9, 14.4]	12.0 [10.9, 13.1]	1.1	0.1685
Armenia	2000	2.2 [1.2, 3.7]	5.4 [4.3, 6.7]	3.6 [2.8, 4.5]	7.8 [6.5, 9.2]	-4.2	0.0000
(Yerevan)	2005	11.2 [9.0, 13.9]	11.2 [9.5, 13.3]	11.2 [9.8, 12.9]	9.5 [8.0, 11.3]	1.7	0.1294
	2015	6.4 [4.3, 9.4]	5.4 [4.4, 6.6]	5.9 [4.7, 7.5]	5.3 [4.2, 6.8]	0.6	0.5192
AMERICAS REGION							
Bolivia	2003	21.5 [16.4, 27.7]	13.2 [11.4, 15.2]	15.4 [13.5, 17.6]	14.8 [12.6, 17.3]	0.6	0.6785
(La Paz)	2008	25.0 [21.3, 29.1]	16.0 [14.0, 18.3]	18.9 [17.1, 20.9]	17.6 [15.1, 20.4]	1.3	0.4470

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. The estimate for women living in the capital and other urban areas is missing for Nepal 2011, as the survey does not identify whether urban citizens are living in the capital city or elsewhere.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural). Statistical significance= p-value <0.05.

Table 8.4. (continued)

		Area of residence*					
Country *(capital)*	**Survey year**	**Capital**	**Other urban**	**Total urban**	**Rural**	**Gap†**	**p-value**
AMERICAS REGION							
Haiti	2000	19.3 [15.0, 24.6]	15.0 [12.1, 18.3]	18.3 [14.8, 22.5]	8.0 [6.4, 10.0]	10.3	0.0000
(Port-au-Prince)	2005	15.6 [12.3, 19.6]	11.6 [9.3, 14.3]	14.1 [11.8, 16.7]	5.5 [4.4, 6.9]	8.6	0.0000
	2012	17.7 [14.9, 20.8]	16.0 [14.0, 18.2]	16.9 [15.1, 18.9]	9.5 [8.0, 11.3]	7.4	0.0000
	2016	21.3 [18.3, 24.5]	19.5 [17.4, 21.9]	20.5 [18.6, 22.6]	13.0 [11.5, 14.5]	7.5	0.0000
Honduras	2005	6.6 [5.1, 8.5]	11.7 [10.4, 13.1]	10.1 [9.1, 11.3]	7.7 [7.0, 8.6]	2.4	0.0005
(Tegucigalpa)	2011	9.4 [7.8, 11.3]	10.9 [9.9, 12.0]	10.5 [9.7, 11.4]	7.4 [6.7, 8.1]	3.1	0.0000
Peru	2000	18.5 [15.9, 21.5]	14.2 [12.5, 16.1]	16.2 [14.7, 17.9]	13.9 [11.9, 16.1]	2.3	0.0915
(Lima)	2007	15.4 [13.4, 17.6]	13.1 [12.2, 14.0]	14.0 [13.0, 14.9]	10.8 [9.8, 11.8]	3.2	0.0000
	2009	15.4 [13.4, 17.6]	10.7 [9.9, 11.6]	11.6 [10.8, 12.6]	8.5 [7.5, 9.6]	3.1	0.0000
	2010	11.3 [9.6, 13.1]	10.5 [9.7, 11.4]	10.8 [10.0, 11.7]	9.2 [8.3, 10.2]	1.6	0.0172
	2011	9.2 [8.0, 10.7]	9.1 [8.4, 9.9]	9.2 [8.5, 9.9]	7.7 [6.8, 8.8]	1.5	0.0264
	2012	8.3 [7.0, 9.7]	10.0 [9.3, 10.7]	9.3 [8.6, 10.0]	9.7 [8.8, 10.8]	-0.4	0.4676

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. The estimate for women living in the capital and other urban areas is missing for Nepal 2011, as the survey does not identify whether urban citizens are living in the capital city or elsewhere.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural). Statistical significance= p-value <0.05.

Table 8.4. (continued)

		Area of residence*					
Country *(capital)*	**Survey year**	**Capital**	**Other urban**	**Total urban**	**Rural**	**Gap†**	**p-value**
SOUTHEAST ASIAN REGION							
India *(Mumbai &*	2005	11.4 [10.6, 12.3]	12.0 [11.7, 12.4]	11.9 [11.6, 12.2]	4.2 [4.0, 4.4]	7.7	0.0000
New Delhi)	2015	12.0 [11.0, 13.1]	17.0 [16.6, 17.4]	16.9 [16.5, 17.3]	8.4 [8.3, 8.5]	8.5	0.0000
Nepal	2006	3.7 [2.4, 5.5]	4.8 [3.8, 6.1]	4.3 [3.4, 5.3]	1.8 [1.3, 2.5]	2.5	0.0000
(Kathmandu)	2011	-	-	7.2 [5.7, 9.0]	2.9 [2.2, 3.7]	4.3	0.0000
	2016	11.2 [8.3, 15.0]	8.4 [7.0, 10.1]	9.2 [7.8, 10.8]	6.0 [4.8, 7.6]	3.2	0.0031
Timor-Leste	2009	4.2 [2.0, 8.6]	1.7 [0.7, 3.7]	3.3 [1.8, 6.2]	0.8 [0.5, 1.5]	2.5	0.0004
(Dili)	2016	5.6 [3.5, 8.6]	3.6 [2.2, 5.8]	5.0 [3.5, 7.2]	1.3 [0.8, 1.9]	3.7	0.0000
WESTERN PACIFIC REGION							
Cambodia	2000	1.1 [0.1, 10.3]	4.8 [2.6, 8.7]	3.5 [2.0, 6.3]	3.6 [2.8, 4.6]	-0.1	0.9827
(Phnom Penh)	2005	2.3 [0.7, 7.5]	5.3 [4.2, 6.7]	4.2 [3.2, 5.6]	3.5 [3.0, 4.1]	0.7	0.2684
	2010	4.3 [2.5, 7.2]	6.1 [4.7, 7.8]	5.1 [3.9, 6.7]	4.3 [3.5, 5.2]	0.8	0.3142
	2014	7.8 [6.0, 10.2]	9.3 [8.1, 10.7]	8.6 [7.4, 9.9]	7.4 [6.6, 8.4]	1.2	0.1435

DRC, Democratic Republic of the Congo
*Values are percentages and 95% CIs; estimates account for survey design. The estimate for women living in the capital and other urban areas is missing for Nepal 2011, as the survey does not identify whether urban citizens are living in the capital city or elsewhere.
† Gaps are expressed in percentage points and indicate the difference between urban and rural areas (urban-rural). Statistical significance= p-value <0.05.

8.2.2. Overall trends in the magnitude of intra-individual DBM in the 33 LMICs

Overall, the prevalence of concurrent overweight/obesity and anaemia among adult women living in the 33 LMICs included in the study increased over time at an annual rate of 0.17 pp (95% CI: 0.07, 0.27) over the past two decades (**Table 8.5** and **Figure 8.1 A**). Simultaneously, the overall prevalence of overweight/obesity increased rapidly (AARC=0.73 pp, 95% CI: 0.59, 0.86), while the prevalence of anaemia declined at a slower pace (AARC=-0.36 pp, 95% CI: -0.60, -0.12) from 2000 to 2019 (**Table 8.5**).

Figure 8.1 illustrates the trend of concurrent overweight/obesity and anaemia prevalence in the 33 countries, overall and by sociodemographic characteristics, where the slopes of the trend line represent the AARC in intra-individual DBM and corresponds with the values presented in **Table 8.5**. These show increases in the prevalence of concurrent overweight/obesity and anaemia for all sub-groups, particularly those in the three middle wealth groups (0.18 pp to 0.19 pp), women with no education (0.16 pp), and capital (0.16 pp) and rural (0.18 pp) residents. The rising trend was not statistically significant among women in the richest category, primary and secondary education levels, and those living in other urban areas (**Table 8.5**).

Figure 8.2 displays the AARC in pp of concurrent overweight/obesity and anaemia for each individual country and enables comparing the intra-individual DBM trends with the country-specific trend in prevalence of overweight/obesity and anaemia separately.

An additional figure showing trends in the prevalence of overweight/obesity and anaemia among adult women for every country (i.e., concurrent overweight/obesity and anaemia, overweight/obesity only, anaemia only, no overweight/obesity or anaemia) is available in **Appendix B**. This figure shows multiple patterns across countries. For example, in countries such as Cameroon, Ghana, Tanzania, India or Cambodia, the prevalence of DBM and overweight/obesity only appear to have increased over time, while anaemia only (concurrently with normal weight or underweight) has decreased. In others, such as Uganda and Rwanda, overweight only has increased, while anaemia only has decreased over time, and DBM has remained more or less stagnant. Peru shows another distinct pattern with increases in overweight/obesity and reductions in anaemia across all BMI groups (i.e., DBM and anaemia only). These observed changes in patterns could be attributed to the different stage of the nutrition transition a country was undergoing at data collection,

Table 8.5. Average annual rate of change (AARC) in the prevalence of intra-individual double burden of overweight/obesity and anaemia (overall and by sociodemographic characteristics) and in the overall prevalence of overweight/obesity and prevalence of anaemia.

	All LMICs (n=95 surveys)	**AFRO** (n=58 surveys)	**EMRO** (n=7 surveys)	**EURO** (n=5 surveys) §	**PAHO** (n=14 surveys)	**SEARO** (n=7 surveys)	**WPRO** (n=4 surveys) ‡
Concurrent overweight obesity and anaemia							
Total	0.17*(0.07, 0.27)	0.17**(0.07, 0.27)	0.37 (-0.14, 0.89)	0.07 (-0.27, 0.40)	-0.04 (-0.34, 0.25)	0.41**(0.24, 0.59)	0.27*(0.11, 0.44)
Wealth							
Poorest (Q1)	0.11*(0.02, 0.20)	0.07 (-0.01, 0.16)	0.65*(0.20, 1.01)	-0.11 (-0.29, 0.07)	-0.04 (-0.31, 0.22)	0.19** (0.08, 0.30)	0.24**(0.12, 0.35)
Poorer (Q2)	0.19**(0.09, 0.30)	0.21**(0.10, 0.32)	0.42 (-0.10, 0.94)	-0.07 (-0.30, 0.16)	0.01 (-0.31, 0.34)	0.39**(0.26, 0.52)	0.34*(0.13, 0.55)
Middle (Q3)	0.18*(0.07, 0.29)	0.23**(0.12, 0.38)	0.28 (-0.27, 0.82)	0.05 (-0.32, 0.41)	-0.22 (-0.56, 0.13)	0.47**(0.25, 0.69)	0.40**(0.26, 0.55)
Richer (Q4)	0.18*(0.04, 0.32)	0.23*(0.09, 0.37)	0.21 (-0.56, 0.98)	0.20 (-0.20, 0.59)	-0.16 (-0.48, 0.17)	0.63**(0.46, 0.80)	0.10 (-0.14, 0.34)
Richest (Q5)	0.11 (-0.04, 0.25)	0.09 (-0.05, 0.24)	0.47 (-0.25, 1.19)	0.04 (-0.38, 0.46)	-0.20 (-0.59, 0.19)	0.59**(0.33, 0.86)	0.09 (-0.14, 0.33)
Education							
None (E1)	0.16*(0.05, 0.27)	0.17*(0.06, 0.28)	0.17 (-0.38, 0.72)	-	0.01 (-0.26, 0.28)	0.32**(0.17, 0.47)	0.34*(0.11, 0.57)
Primary (E2)	0.08 (-0.04, 0.21)	0.06 (-0.08, 0.19)	0.18 (-0.37, 0.72)	-	-0.13 (-0.50, 0.25)	0.46**(0.30, 0.62)	0.32*(0.11, 0.53)
Secondary+ (E3)	0.07 (-0.05, 0.19)	-0.00 (-0.12, 0.12)	0.41 (-0.17, 1.00)	-	-0.01 (-0.28, 0.26)	0.43**(0.23, 0.63)	0.23**(0.18, 0.29)
Residence							
Capital	0.16*(0.01, 0.31)	0.17*(0.01, 0.34)	0.15 (-0.55, 0.85)	0.40 (-0.14, 0.95)	-0.16 (-0.52, 0.21)	0.37*(0.10, 0.63)	0.46**(0.33, 0.59)
Other urban area	0.11 (-0.01, 0.24)	0.07 (-0.08, 0.21)	0.36 (-0.28, 1.00)	0.06 (-0.33, 0.46)	0.08 (-0.17, 0.33)	0.40**(0.30, 0.50)	0.30**(0.15, 0.45)
Total urban	0.13*(0.01, 0.25)	0.10 (-0.02, 0.22)	0.29 (-0.34, 0.93)	0.22 (-0.23, 0.68)	-0.05 (-0.36, 0.26)	0.45**(0.34, 0.55)	0.34**(0.18, 0.49)
Rural area	0.18**(0.08, 0.28)	0.18**(0.08, 0.28)	0.54*(0.00, 1.08)	-0.12 (-0.31, 0.06)	0.03 (-0.25, 0.31)	0.35**(0.24, 0.47)	0.25*(0.09, 0.42)
Overweight/obesity							
Total	0.73**(0.59, 0.86)	0.83**(0.65, 1.00)	0.27*(0.09, 0.46)	0.52 (-0.01, 1.06)	0.63**(0.39, 0.86)	1.06**(0.63, 1.49)	0.80**(0.49, 1.12)
Anaemia							
Total	-0.36*(-0.60, -0.12)	-0.52*(-0.85, -0.20)	0.45 (-0.27, 1.17)	-0.01 (-0.62, 0.60)	-0.53*(-0.96, -0.10)	0.34*(0.09, 0.59)	-1.03*(-1.63, -0.42)

*p-value <0.05; **p-value <0.001
AFRO, African region; EMRO, Eastern Mediterranean region; EURO, European region; PAHO, Americas region; SEARO, Southeast Asian region; WPRO, Western Pacific region.
§ In the EURO region, the AARC for the different education subgroups could not be calculated due to sample sizes <25 observations for the three groups across both countries (Albania and Armenia).
‡ The WPRO region only had one country with available data (Cambodia), thus the AARC is representative of Cambodia only.

Figure 8.1. Trends in the prevalence of concurrent overweight/obesity and anaemia overall (A) and by household wealth (B), education level (C) and area of residence (D).

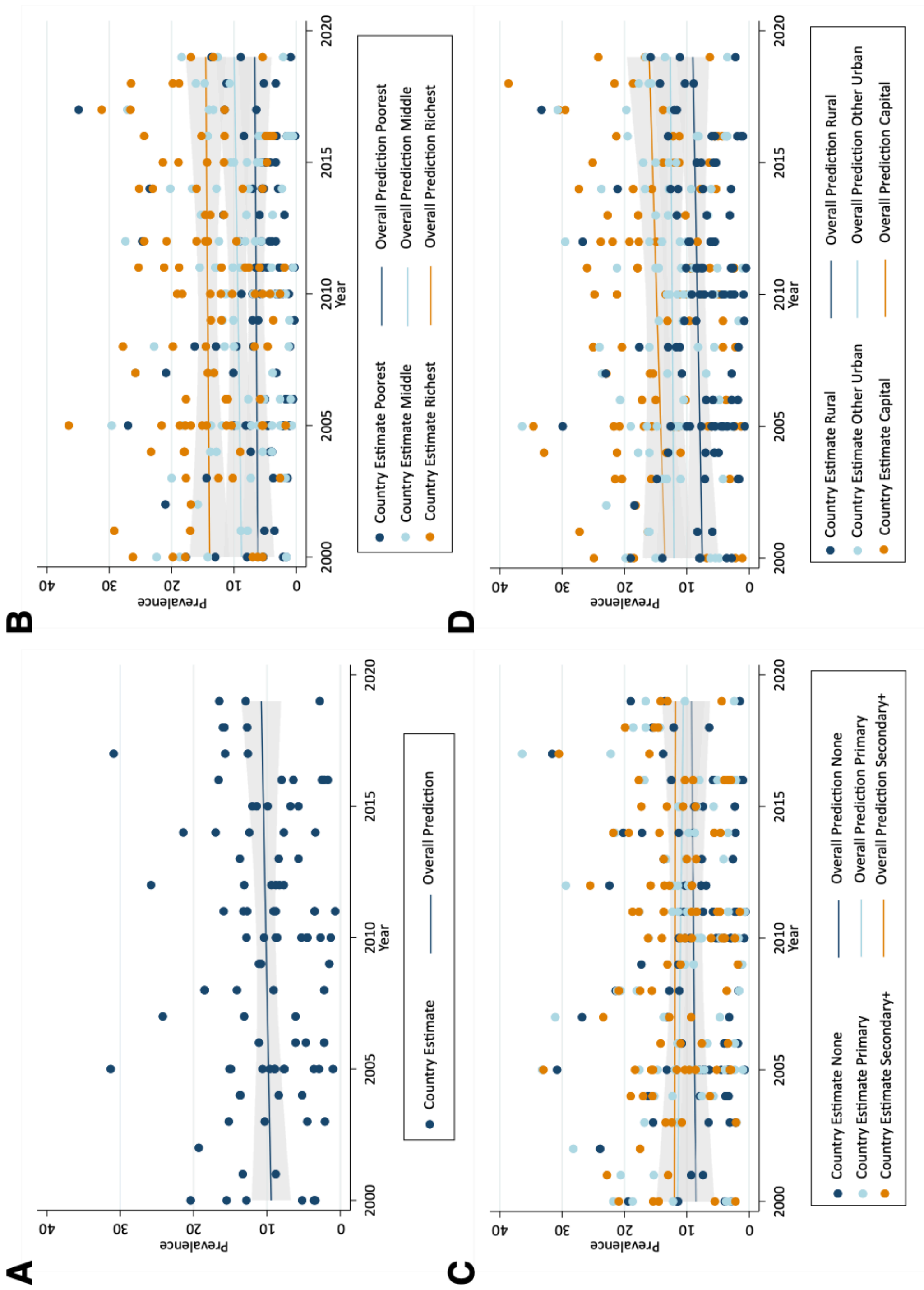
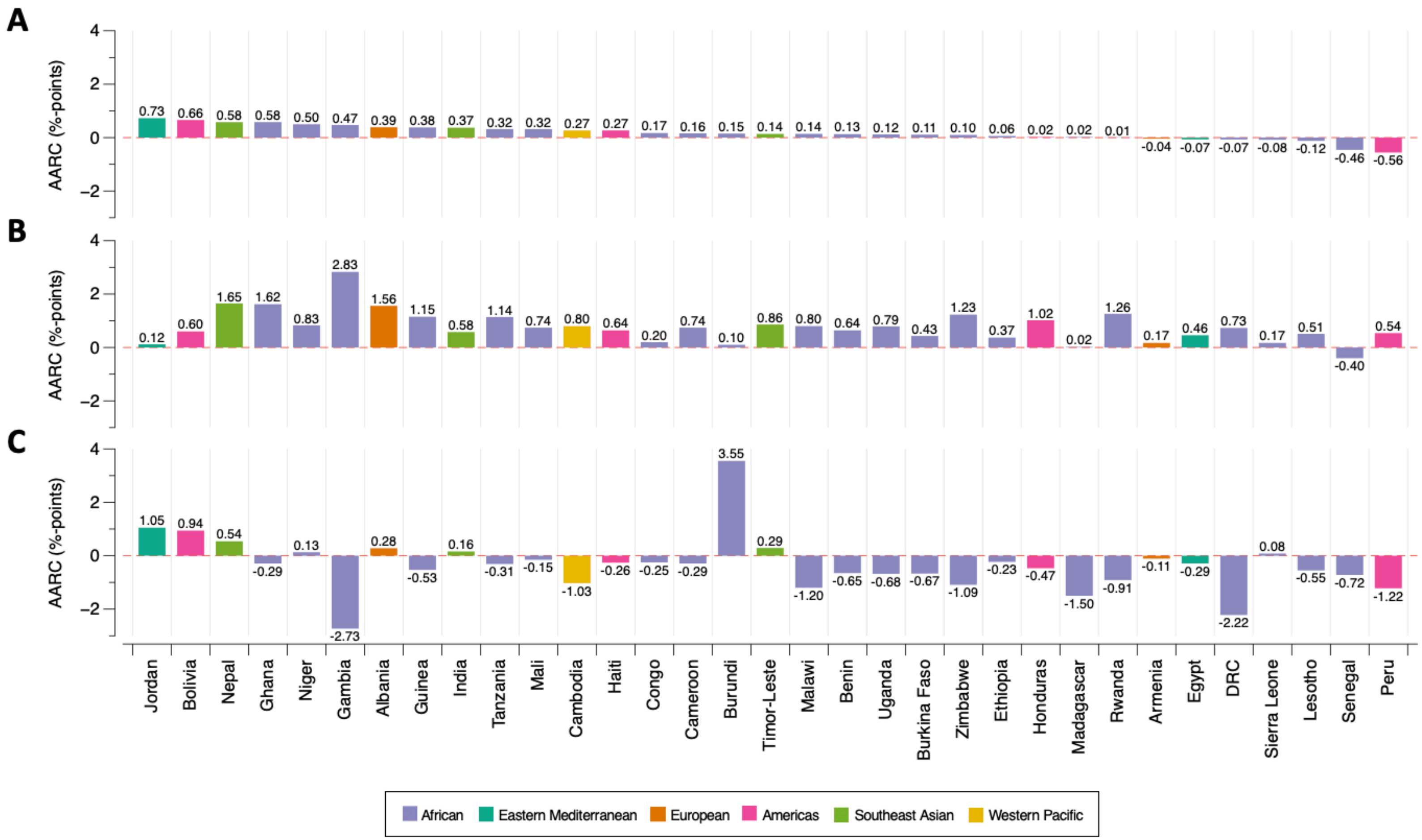


Figure 8.2. Country-level average annual rate of change (AARC) in the prevalence of concurrent overweight/obesity and anaemia (A), overweight/obesity (B), and anaemia (C).



or to the multifactorial aetiology of anaemia; as well as policies and programmes implemented in countries over the past two decades to reduce different forms of malnutrition. Overall, when comparing **Figure 8.2** with **Appendix B**, it is observed that of the nine countries presenting a positive AARC of anaemia, DBM increased and anaemia only increased or remained constant in five countries (Jordan, Bolivia, Nepal, Burundi and Timor-Leste); DBM increased and anaemia only decreased or remained constant in three (Niger, Albania and India); and DBM decreased and anaemia only increased in one country (Sierra Leone). Of the remaining 24 countries with negative AARC of anaemia, six countries had reductions in DBM; while 15 countries experienced different degrees of an increase in DBM, and in three countries (Honduras, Madagascar and Rwanda) the prevalence of DBM remained constant. Of the 15 countries with an observed positive DBM trend and negative AARC values for anaemia, ten countries had important improvements in anaemia only (Ghana, Gambia, Guinea, Cambodia, Haiti, Congo, Cameroon, Malawi, Uganda and Burkina Faso); while five had a fluctuating or stagnant trend in anaemia only (Tanzania, Mali, Benin and Ethiopia).

8.2.3. Trends in the magnitude of intra-individual DBM by WHO regions

8.2.3.1. African region

In the African region, the trend analysis depicts a modest increase in the prevalence of concurrent overweight/obesity and anaemia (AARC=0.17 pp, 95%: 0.07, 0.27) across the 21 countries included (**Table 8.5** and **Figure 8.3**). The prevalence of overweight/obesity has been increasing steadily since 2000 at an annual rate of 0.83 pp (95% CI: 0.65, 1.00); while anaemia decreased an average of 0.52 pp (95% CI: -0.85, -0.20) annually.

The most rapid increase in concurrent overweight/obesity and anaemia was observed in the three middle wealth groups (i.e., poorer, middle and richer), women with no education, and those living in capital cities or rural areas; whereas the trend was increasing but not significantly (p-value>0.05) among women in the poorest and richest groups, those with primary education, and women living in other urban areas (**Table 8.5** and **Figure 8.3**). Women in the African region with secondary or higher education did not seem to experience an increase or decrease in the prevalence of concurrent overweight/obesity and anaemia (-0.00 pp). This regional picture masks important differences across subregions (**Table 8.6**). Comparing the ESA and WCA subregions, there was an almost three times larger annual increase in concurrent overweight/obesity and anaemia in WCA (AARC: 0.24 pp, 95% CI: 0.08, 0.40), particularly among the three middle wealth groups (0.32 pp to 0.35 pp), women with no education (0.30 pp) and those living in rural areas (0.28 pp). In the ESA, the most rapid increase in intra-individual DBM was observed among women living in capital cities (AARC: 0.17 pp, 95% CI: 0.02, 0.32).

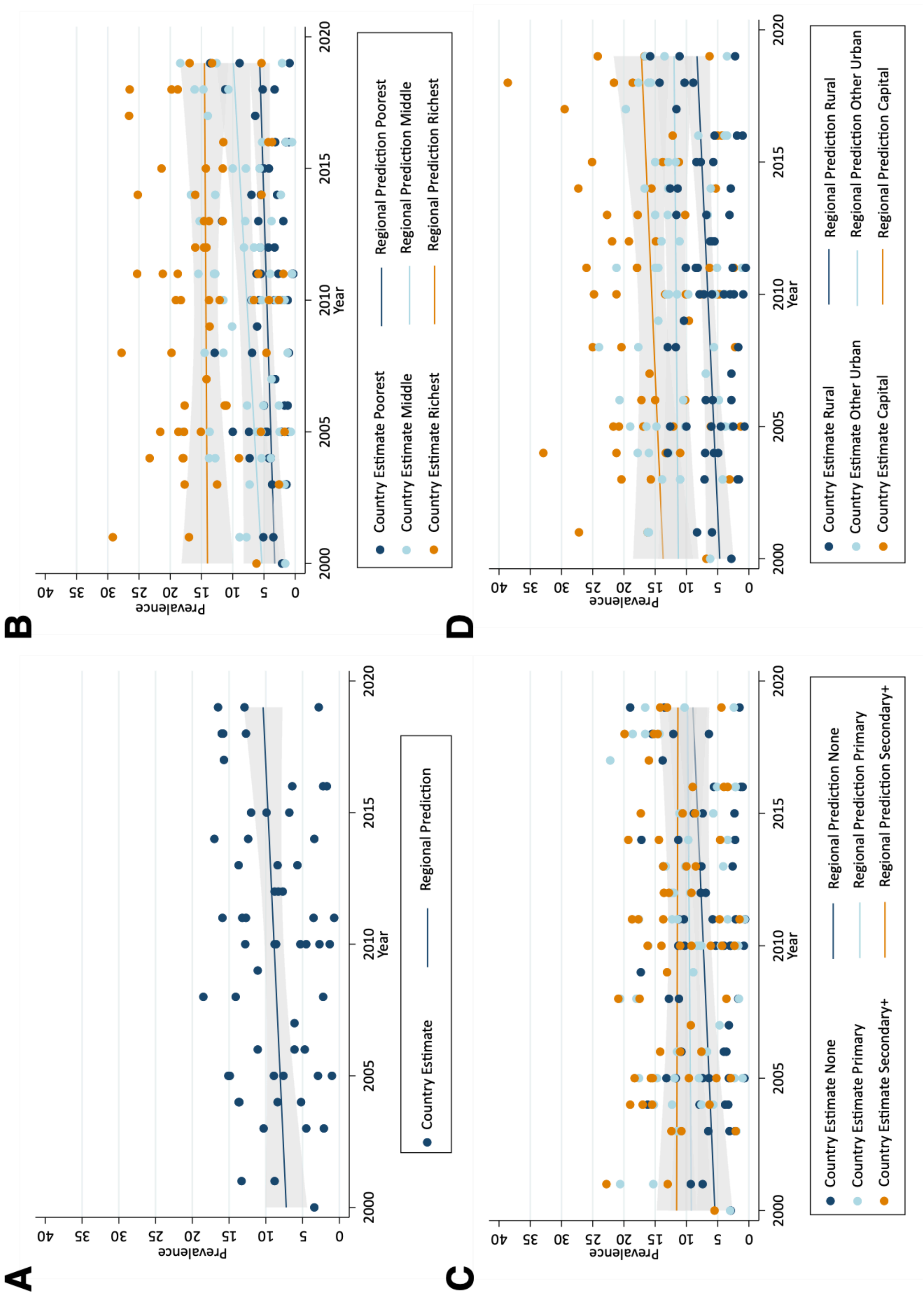
Figure 8.2 shows that the AARC of concurrent overweight/obesity and anaemia was positive in 17/21 countries within the African region, ranging from 0.58 pp in Ghana ($AARC_{overweight/obesity}$=1.62 pp; $AARC_{anaemia}$= -0.29 pp) to 0.01 in Rwanda ($AARC_{overweight/obesity}$=1.26 pp; $AARC_{anaemia}$= -0.91 pp); whereas it was negative in 4/21 countries, ranging from -0.07 pp in the DRC ($AARC_{overweight/obesity}$=0.73 pp; $AARC_{anaemia}$= -2.22 pp) to -0.46 pp in Senegal ($AARC_{overweight/obesity}$= -0.40 pp; $AARC_{anaemia}$= -0.72 pp).

Table 8.6. Average annual rate of change (AARC) in the prevalence of the double burden of overweight/obesity and anaemia in the Western and Central African (WCA) and Eastern and Southern African (ESA) subregions.

	WCA (n=31 surveys)	**ESA** (n=27 surveys)
Concurrent overweight/obesity and anaemia		
Total	0.24*(0.08, 0.40)	0.09*(0.01, 0.18)
Wealth		
Poorest (Q1)	0.13 (-0.01, 0.28)	0.01 (-0.06, 0.08)
Poorer (Q2)	0.35**(0.18, 0.52)	0.04 (-0.04, 0.13)
Middle (Q3)	0.32**(0.15, 0.50)	0.11*(0.02, 0.21)
Richer (Q4)	0.35*(0.12, 0.57)	0.09 (-0.05, 0.23)
Richest (Q5)	0.06 (-0.18, 0.29)	0.13 (-0.12, 0.27)
Education		
None (E1)	0.30**(0.16, 0.45)	0.01 (-0.14, 0.16)
Primary (E2)	0.06 (-0.17, 0.29)	0.05 (-0.05, 0.14)
Secondary+ (E3)	-0.05 (-0.25, 0.15)	0.07 (-0.02, 0.16)
Residence		
Capital	0.19 (-0.08, 0.47)	0.17*(0.02, 0.32)
Other urban area	0.06 (-0.18, 0.30)	0.06 (-0.09, 0.21)
Total urban	0.08 (-0.11, 0.28)	0.10 (-0.01, 0.21)
Rural area	0.28**(0.12, 0.43)	0.06 (-0.02, 0.15)
Overweight/obesity		
Total	0.82**(0.54, 1.11)	0.84**(0.67, 1.02)
Anaemia		
Total	-0.46*(-0.87, -0.06)	-0.67*(-1.16, -0.20)

*p-value<0.05; **p-value<0.001
WCA: Benin, Burkina Faso, Cameroon, Congo, DRC, Gambia, Ghana, Guinea, Mali, Niger, Senegal, Sierra Leone.
ESA: Burundi, Ethiopia, Lesotho, Madagascar, Malawi, Rwanda, Tanzania, Uganda, Zimbabwe.

Figure 8.3. Trends in the prevalence of concurrent overweight/obesity and anaemia overall (A) and by household wealth (B), education level (C) and area of residence (D) in the African region.



8.2.3.2. Eastern Mediterranean region

In the Eastern Mediterranean region, the trend analysis suggests an increasing annual trend of 0.37 pp (95% CI: -0.14, 0.89) in concurrent overweight/obesity, although not statistically significant across all subgroups, with the exception of women in the poorest groups (0.65 pp) and those living in rural areas (0.54 pp), where the largest annual increases in intra-individual DBM were observed regionally (**Table 8.5** and **Figure 8.4**). Separately, the prevalence of overweight/obesity, and that of anaemia have been increasing steadily since 2000; however, only the AARC for overweight/obesity was found to be statistically significant (AARC=0.27 pp, 95% CI: 0.09, 0.46). Regionally, and across all LMICs, Jordan experienced the highest annual rise in concurrent overweight/obesity and anaemia, with an AARC of 0.73 pp ($AARC_{overweight/obesity}$=0.12 pp; $AARC_{anaemia}$=1.05 pp); whereas in Egypt the prevalence of DBM remained stable with an AARC of -0.07 pp ($AARC_{overweight/obesity}$=0.46 pp; $AARC_{anaemia}$= -0.29 pp) (**Figure 8.2**).

8.2.3.3. European region

In the European region, the trend analyses yielded non statistically significant values across all subgroups. **Table 8.5** and **Figure 8.5** highlight a small, but positive, increase in concurrent overweight/obesity and anaemia over the past two decades, with an AARC of 0.07 pp (95% CI: -0.27, 0.40). Overweight/obesity increased at an annual rate of 0.52 pp (95% CI: -0.01, 1.06); while anaemia experienced almost no change (AARC= -0.01 pp, 95% CI: -0.62, 0.60). However, this scenario seems to differ in the two countries with available data included in the regional analysis. Specifically, women living in Albania had the highest increase in intra-individual DBM in the region, with a 0.39 pp ($AARC_{overweight/obesity}$=1.56 pp; $AARC_{anaemia}$=0.28 pp)) (**Figure 8.2**). In Armenia, the AARC was -0.04 pp, with a modest annual increase in the prevalence of overweight/obesity (0.17 pp) and a small decline in the prevalence of anaemia (-0.11 pp).

8.2.3.4. Americas region

In the Americas region, the AARC of concurrent overweight/obesity and anaemia was the smallest of all WHO regions (AARC=-0.04, 95% CI: -0.34, 0.25), with no statistically significant values across subgroups (**Table 8.5**). There was a large significant increase in overweight/obesity since 2000, at an annual rate of 0.63 pp (95% CI: 0.39, 0.86) and simultaneous decline in anaemia (AARC= -0.53 pp, 95% CI: -0.96, -0.10). The regional trend, overall and by sociodemographic characteristics, can be also observed in **Figure 8.6**. By individual country, 3/4 LMICs had a positive

AARC, ranging from 0.66 pp in Bolivia ($AARC_{overweight/obesity}$=0.60 pp; $AARC_{anaemia}$=0.94 pp) to 0.02 pp in Honduras ($AARC_{overweight/obesity}$=1.02 pp; $AARC_{anaemia}$=-0.47 pp). In Peru, the situation differed, with a steady decline in concurrent overweight/obesity and anaemia; the largest of all LMICs included in the analysis, at an annual rate of -0.56 pp ($AARC_{overweight/obesity}$=0.54 pp; $AARC_{anaemia}$= -1.22 pp).

8.2.3.5. Southeast Asian region

In the Southeast Asian region, the trend in concurrent overweight/obesity and anaemia indicates an annual rise of 0.41 pp (95% CI: 0.24, 0.59); the most rapid increase of all WHO regions, where both, the prevalence of overweight/obesity (AARC=1.06, 95% CI: 0.63, 1.49) and anaemia (AARC=0.34, 95% CI: 0.09, 0.59) increased substantially over the past two decades (**Table 8.5**). This positive trend in intra-individual DBM was consistent across all subgroups, particularly the richer and richest wealth quintiles (0.63 pp vs 0.59 pp, respectively), women with primary and secondary or higher education (0.46 pp vs 0.43 pp), and women living in urban areas (0.45 pp), although not necessarily capital cities, where the AARC was slightly lower than that in other urban areas (**Table 8.5** and **Figure 8.7**). The AARC for the three countries with available data within the region can be observed **Figure 8.2**, and ranged from 0.58 pp in Nepal ($AARC_{overweight/obesity}$=1.65 pp; $AARC_{anaemia}$=0.54 pp) to 0.14 pp in Timor-Leste ($AARC_{overweight/obesity}$=0.86 pp; $AARC_{anaemia}$=0.29 pp).

8.2.3.6. Western Pacific region

For the Western Pacific region, the only country with available data was Cambodia, where the prevalence of concurrent overweight/obesity and anaemia increased at an annual rate of 0.27 pp (95% CI: 0.11, 0.44) since 2000 (**Table 8.5,** and **Figures 8.2** and **8.8**); the prevalence of overweight/obesity increased (AARC=0.80 pp, 95% CI: 0.49, 1.12) and anaemia declined significantly (AARC=-1.03, 95% CI: -1.63, -0.42). **Table 8.5** and **Figure 8.8** further indicates a rise in intra-individual DBM across all subgroups, particularly among the middle wealth quintile (0.40 pp), and women living in the capital city (0.46 pp); whereas the AARC was positive but not statistically significant among richer and richest subgroups.

Figure 8.4. Trends in the prevalence of concurrent overweight/obesity and anaemia overall (A) and by household wealth (B), education level (C) and area of residence (D) in the Eastern Mediterranean region.

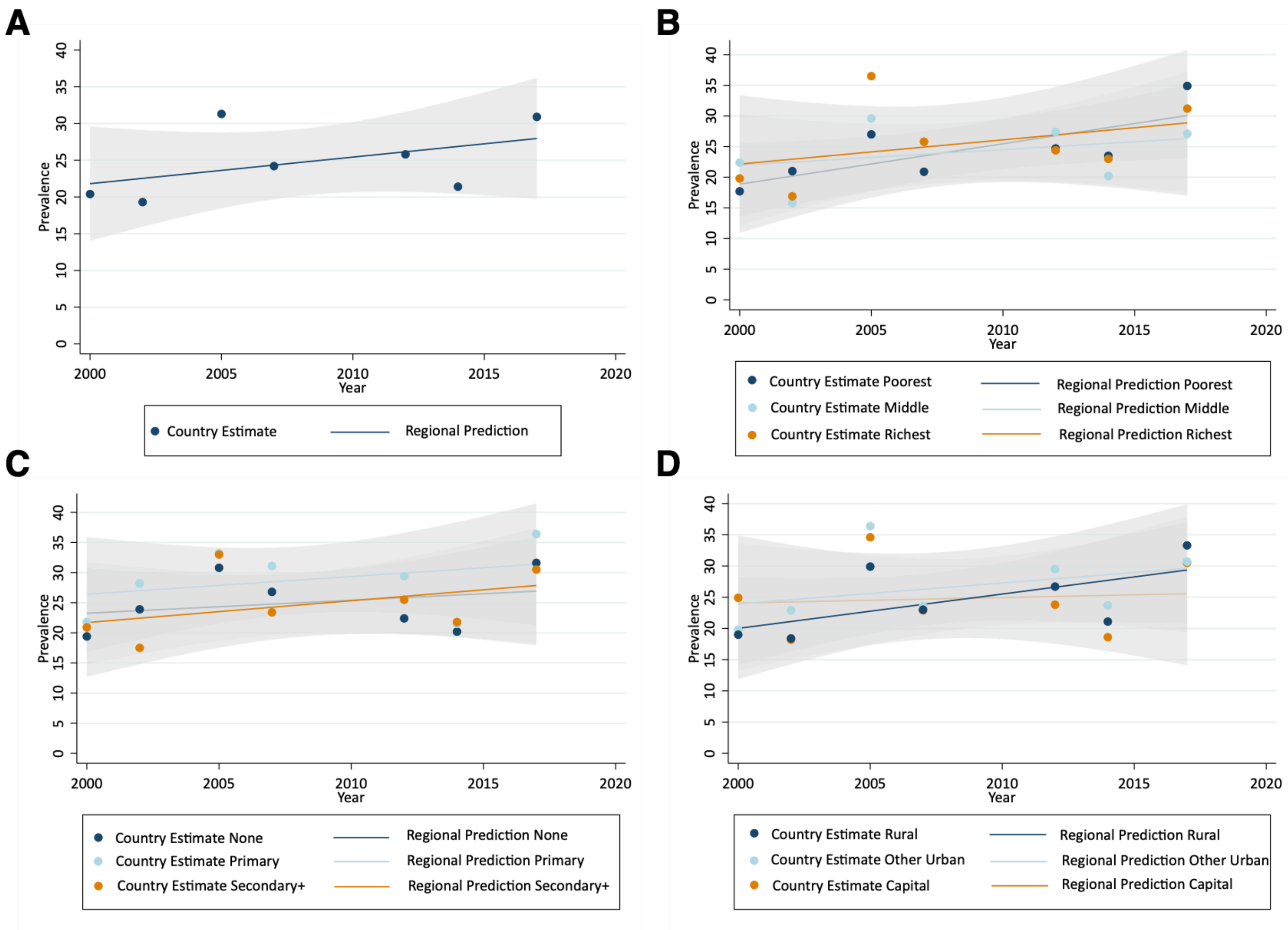


Figure 8.5. Trends in the prevalence of concurrent overweight/obesity and anaemia overall (A) and by household wealth (B) and area of residence (C) in the European region.

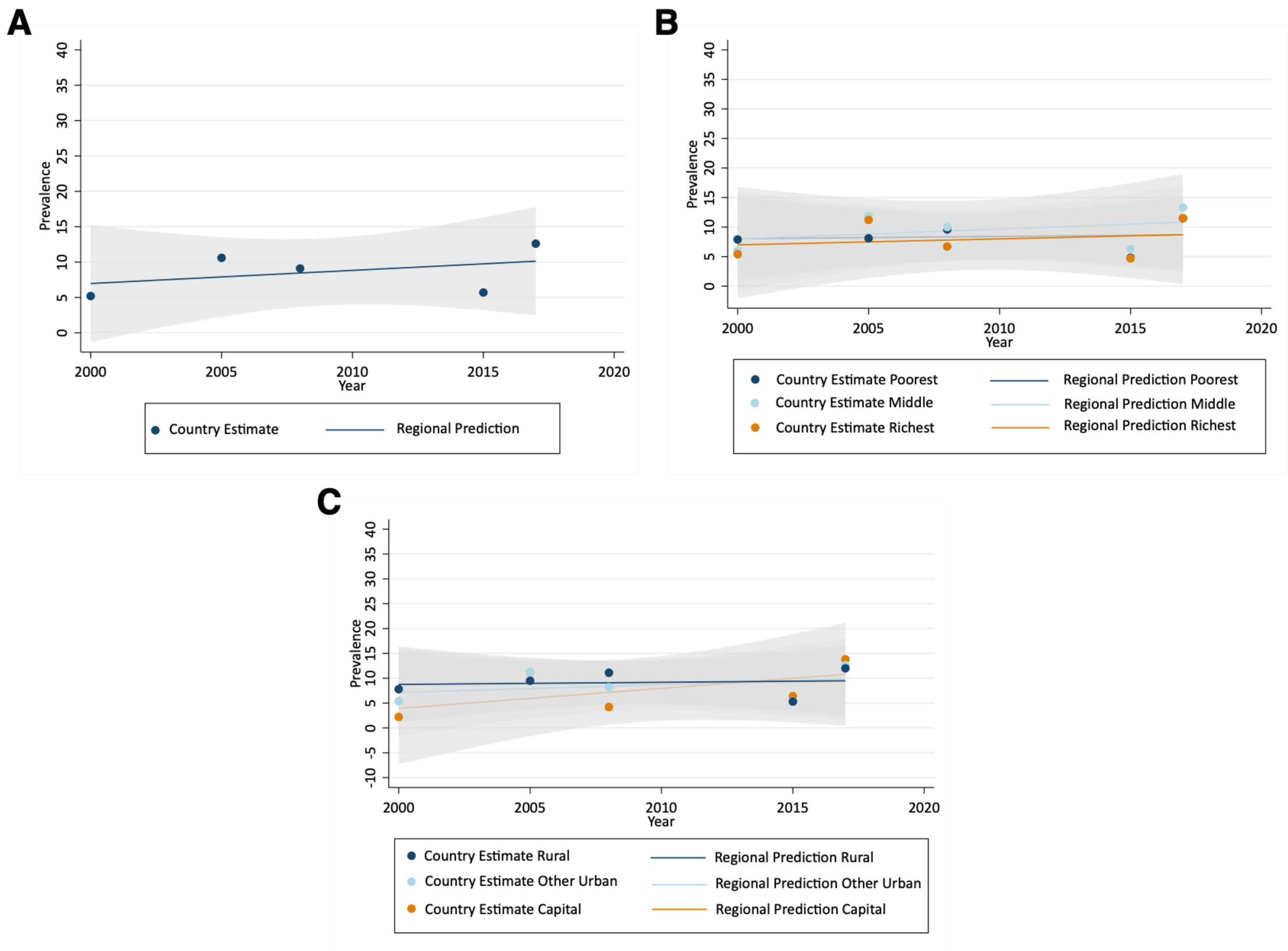


Figure 8.6. Trends in the prevalence of concurrent overweight/obesity and anaemia overall (A) and by household wealth (B), education level (C) and area of residence (D) in the Americas region.

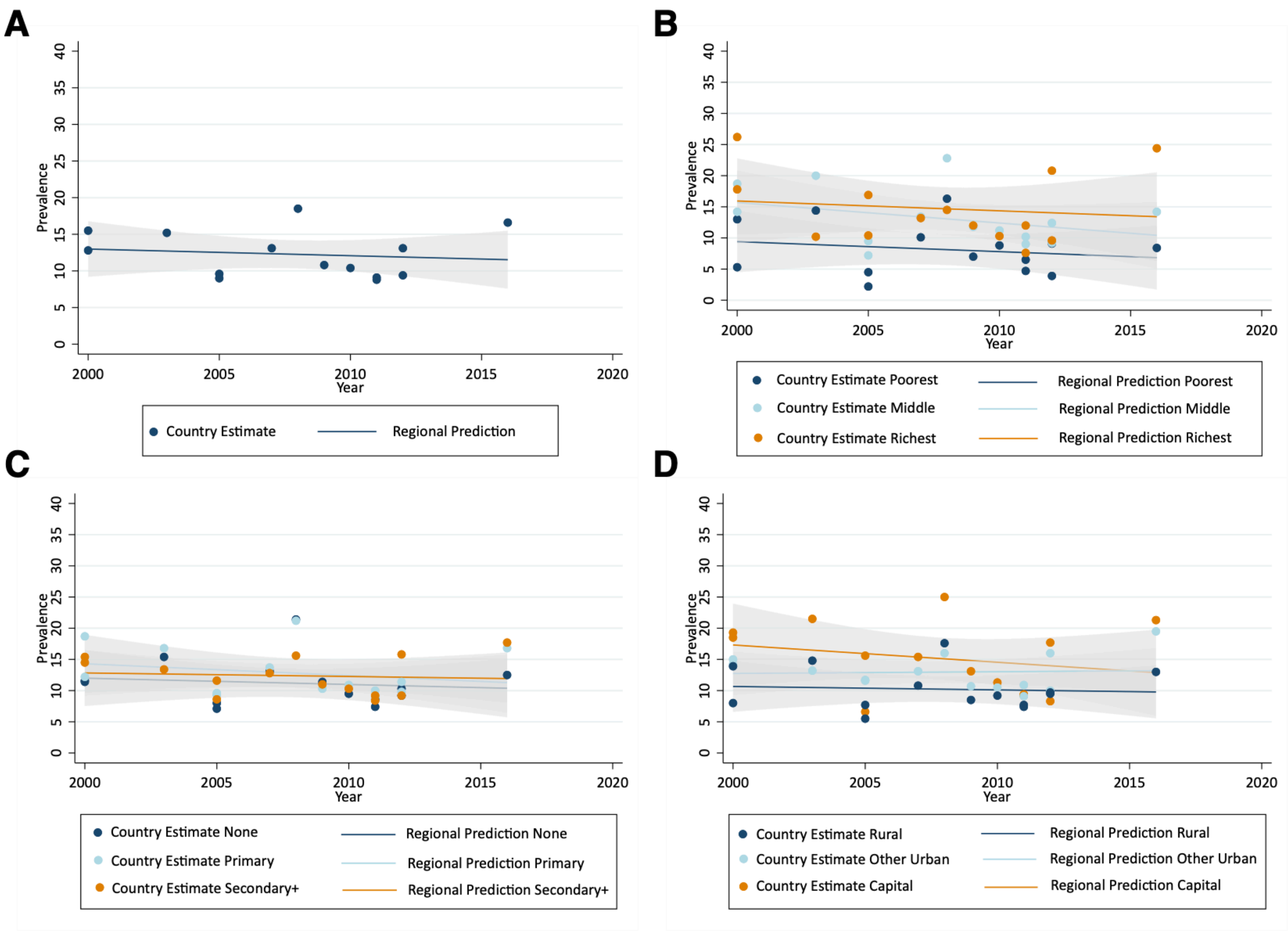


Figure 8.7. Trends in the prevalence of concurrent overweight/obesity and anaemia overall (A) and by household wealth (B), education level (C) and area of residence (D) in the Southeast Asian region.

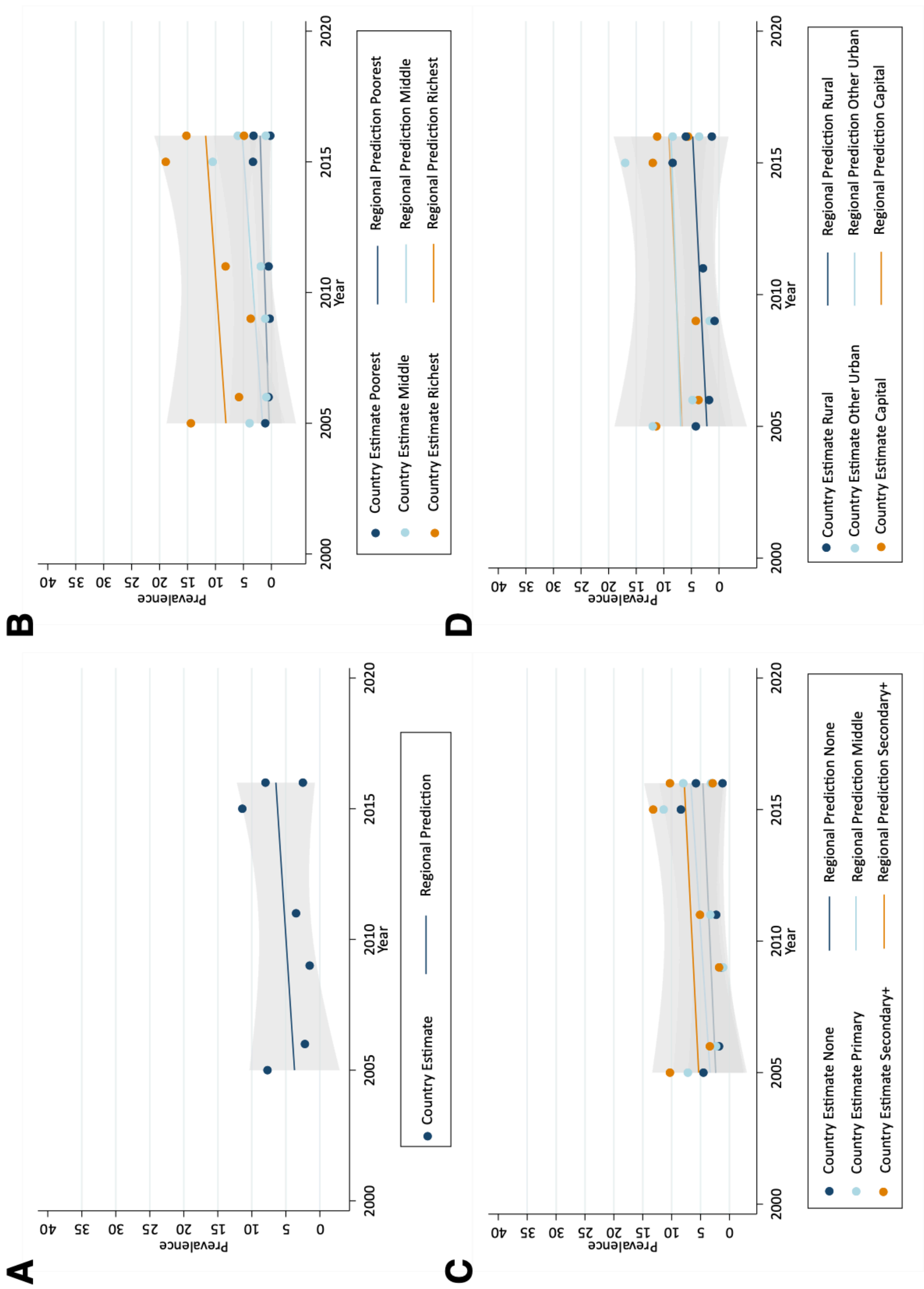
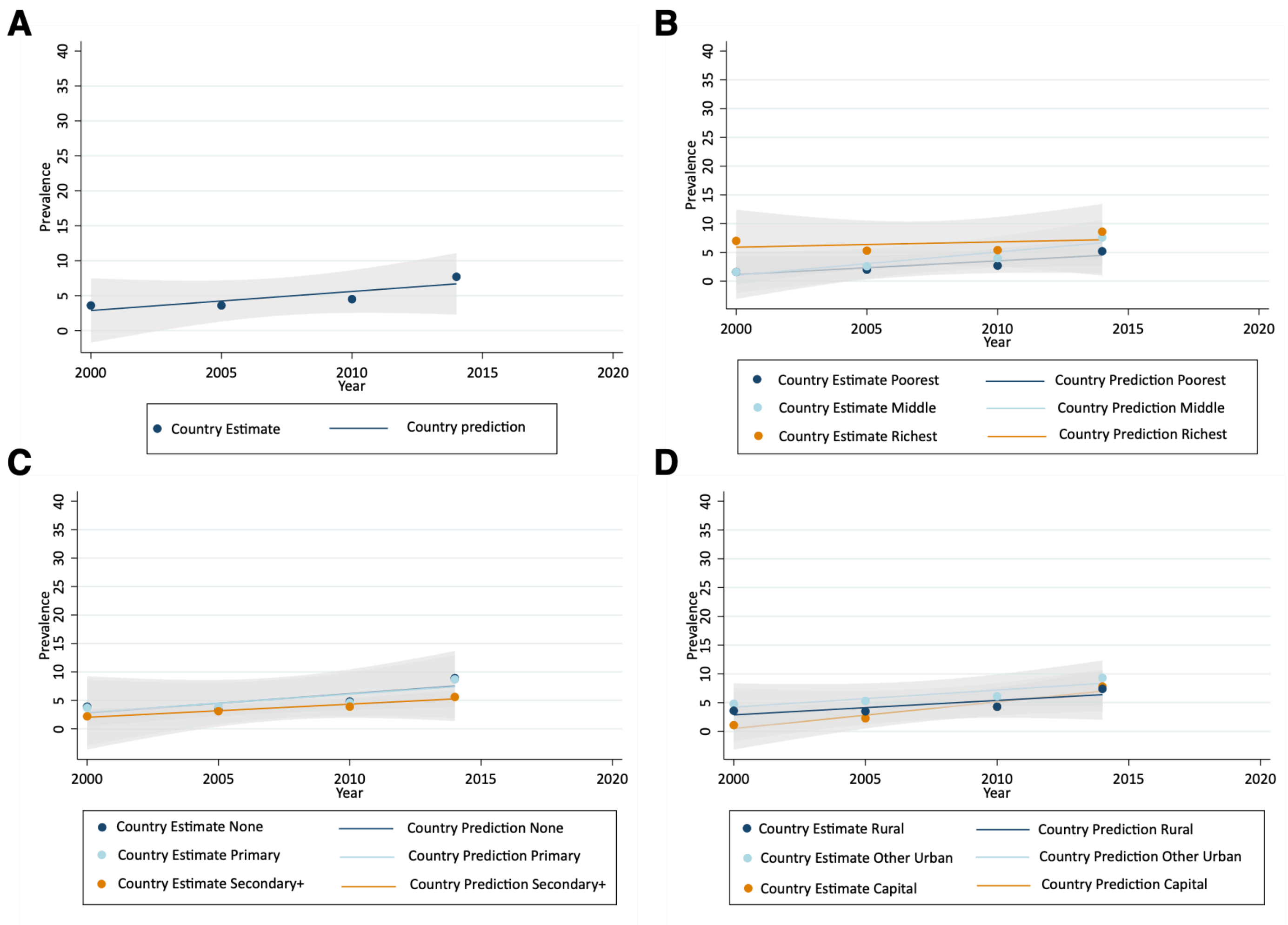


Figure 8.8. Trends in the prevalence of concurrent overweight/obesity and anaemia overall (A) and by household wealth (B), education level (C) and area of residence (D) in the Western Pacific region.



8.2.4. Trends in the intra-individual DBM by World Bank Income classification

The trend in concurrent overweight/obesity and anaemia, which is displayed in **Table 8.7**, indicates a significant annual rise of 0.18 pp in low-income and lower-middle income countries, where the prevalence of overweight/obesity increased rapidly (0.85 pp and 0.79 pp, respectively) and anaemia decreased (-0.51 and -0.39, respectively). This positive trend was also observed in upper-middle-income countries; however, the AARC value was not significant (AARC=0.13, 95% CI: -0.20, 0.46). In these countries, the prevalence of overweight/obesity rose at a slower pace than low-income and lower-middle-income countries (AARC: 0.39, 95% CI: 0.10, 0.68); whereas the trend in anaemia was positive, but close to zero and not significant (AARC: 0.04, 95% CI: -0.54, 0.63). **Table 8.7** further highlights trends in the intra-individual DBM among adult women for the different subgroups.

Table 8.7. Average annual rate of change (AARC) in the prevalence of intra-individual double burden of overweight/obesity and anaemia by World Bank Income classification.

	Low-income (n=36 surveys)	**Lower-middle-income** (n=44 surveys)	**Upper-middle-income** (n=15 surveys)
Concurrent overweight/obesity and anaemia			
Total	0.18*(0.67, 0.30)	0.18*(0.03, 0.33)	0.13 (-0.20, 0.46)
Wealth			
Poorest (Q1)	0.11 (-0.10, 0.23)	0.11*(0.01, 0.22)	0.14 (-0.24, 0.52)
Poorer (Q2)	0.24*(0.09, 0.39)	0.24**(0.11, 0.37)	0.06 (-0.29, 0.41)
Middle (Q3)	0.23**(0.11, 0.35)	0.19* (0.02, 0.36)	0.06 (-0.34, 0.46)
Richer (Q4)	0.25*(0.10, 0.41)	0.09 (-0.14, 0.33)	0.19 (-0.18, 0.56)
Richest (Q5)	0.11 (-0.05, 0.26)	0.11 (-0.13, 0.34)	0.09 (-0.33, 0.52)
Education			
None (E1)	0.22*(0.08, 0.35)	0.13 (-0.04, 0.29)	0.11 (-0.23, 0.45)
Primary (E2)	0.06 (-0.10, 0.21)	0.14 (-0.05, 0.32)	-0.08 (-0.49, 0.34)
Secondary+ (E3)	0.03 (-0.09, 0.16)	0.06 (-0.13, 0.24)	0.26 (-0.16, 0.67)
Residence			
Capital	0.12 (-0.06, 0.30)	0.18 (-0.06, 0.41)	0.20 (-0.25, 0.65)
Other urban area	0.08 (-0.08, 0.25)	0.12 (-0.09, 0.34)	0.12 (-0.18, 0.41)
Total urban	0.10 (-0.03, 0.23)	0.13 (-0.06, 0.32)	0.17 (-0.19, 0.53)
Rural area	0.22*(0.09, 0.34)	0.16*(0.04, 0.31)	0.15 (-0.21, 0.52)
Overweight/obesity			
Total	0.85**(0.62, 1.09)	0.79**(0.63, 0.96)	0.39*(0.10, 0.68)
Anaemia			
Total	-0.51*(-0.93, -0.08)	-0.39*(-0.72, -0.07)	0.04 (-0.54, 0.63)

*p-value<0.05; **p-value<0.001

Low-income: Burkina Faso, Burundi, Democratic Republic of the Congo, Ethiopia, Gambia, Guinea, Madagascar, Malawi, Mali, Niger, Rwanda, Sierra Leone, Uganda.

Lower-middle-income: Benin, Cameroon, Congo, Ghana, Lesotho, Senegal, Tanzania, Zimbabwe, Egypt, Bolivia, Haiti, Honduras, India, Nepal, Timor-Leste, Cambodia.

Upper-middle-income: Jordan, Albania, Armenia, Peru.

8.2.5. Trends in inequalities of intra-individual DBM for each LMIC

Annual changes in pp at the country-level are summarised in **Table 8.8** for the absolute and relative measures of inequality used in this chapter: SII and CIX for wealth and education-related inequalities and inequality gap for residence. These summary measures are presented together with AARC values for the overall trend in the magnitude of intra-individual DBM and that of the two most extreme subgroups: Q1 and Q5 for household wealth, E1 and E3 for education level, and urban and rural for residence.

8.2.5.1. Changes over time in wealth-related inequalities

Overall, absolute inequalities increased in 20 of the 33 LMICs, while relative inequalities rose in 17 countries (**Table 8.8**). The remaining 13 and 16 countries show improvements in absolute and relative inequalities, respectively.

Figure 8.9 shows a scatter diagram of annual changes in the two dimensions of inequalities, which corresponds with the values observed in **Table 8.8**. Equity improved according to both indicators in Burkina Faso, the Democratic Republic of the Congo, Gambia, Lesotho, Niger, Zimbabwe, Egypt, Jordan and Cambodia. The worst performers in terms of inequality measures were Burundi, Congo, Ethiopia, Madagascar, Malawi, Rwanda, Senegal, Sierra Leone, Uganda, Albania, Armenia, Bolivia and Honduras. Nevertheless, a reduction in both inequality measures did not necessarily translate in a negative overall trend (**Table 8.8**). In fact, of the nine countries with improvements in equity, six had a positive overall trend in concurrent overweight/obesity and anaemia, including Jordan which was the country with the highest annual increase in DBM prevalence over the past two decades. The opposite (i.e., countries with increases in both, absolute and relative inequality, and a reduction in the overall DBM trend) was also identified in three countries (Senegal, Sierra Leone and Armenia), although the overall annual change was close to zero for Sierra Leone and Armenia.

Equiplots displaying trends in intra-individual DBM by wealth quintile are presented in **Figure 8.10**. This figure allows to better explore changes in patterns in the distribution of DBM over time for every LMIC. For the majority of countries, patterns did not change dramatically, with the highest prevalence of intra-individual DBM among women in the richest groups and the lowest in those from the poorer groups. However, in a few countries, including those in the Eastern Mediterranean and European regions, changes in its distribution appear to be more evident.

Table 8.8. Trends in the prevalence of concurrent overweight/obesity and anaemia overall, by subgroups, and absolute and relative inequalities by country.

		Wealth-related inequalities				Education-related inequalities				Residence-related inequalities		
Country	**Overall**	**Q1**	**Q5**	**SII**	**CIX**	**E1**	**E3**	**SII**	**CIX**	**Urban**	**Rural**	**Gap**
AFRICAN REGION												
Benin	0.13	0.08	-0.25	-1.13	1.36	0.27	-0.47	-0.93	-0.97	0.01	0.20	-0.20
Burkina Faso	0.11	0.20	-0.06	-0.21	-1.98	0.13	0.03	-0.37	-2.36	-0.40	0.17	-0.57
Burundi	0.15	-0.03	0.28	0.42	0.61	0.08	0.28	0.28	-1.27	-0.10	0.17	-0.27
Cameroon	0.16	-0.04	0.23	0.22	-0.06	0.22	0.06	-0.20	-0.44	0.13	0.14	-0.01
Congo	0.17	-0.63	0.62	1.42	1.12	-0.22	0.38	2.23	2.84	0.48	-0.73	1.22
DRC	-0.07	-0.22	-0.07	-0.35	-0.78	-0.10	-0.13	-0.12	-1.08	0.07	0.05	0.02
Ethiopia	0.06	0.03	0.18	0.26	1.98	0.03	0.04	0.11	0.35	0.13	0.03	0.10
Gambia	0.47	0.32	-0.22	-1.07	-1.37	0.88	0.08	-1.45	-1.17	0.23	0.70	-0.47
Ghana	0.58	0.15	0.65	0.18	-0.68	0.42	0.60	0.33	0.02	0.55	0.48	0.07
Guinea	0.38	0.05	0.06	0.06	-0.77	0.43	-0.09	-0.61	-0.42	0.14	0.44	-0.30
Lesotho	-0.12	-0.03	-0.19	-0.14	-0.36	0.10	-0.11	0.37	-0.17	-0.14	-0.16	0.02
Madagascar	0.02	-0.10	0.40	0.66	3.65	-0.10	0.30	0.60	2.04	0.14	0.02	0.12

Q1, poorest; Q5, richest; E1, no education; E3, secondary+; DRC, Democratic Republic of the Congo. Values are AARC in percentage points.

Table 8.8. (continued)

		Wealth-related inequalities				Education-related inequalities				Residence-related inequalities		
Country	**Overall**	**Q1**	**Q5**	**SII**	**CIX**	**E1**	**E3**	**SII**	**CIX**	**Urban**	**Rural**	**Gap**
AFRICAN REGION												
Malawi	0.14	0.02	0.22	0.31	0.02	0.31	0.20	-0.08	-0.71	0.39	0.07	0.33
Mali	0.32	0.42	0.09	-0.51	0.01	0.37	0.03	-0.41	-0.46	0.14	0.44	-0.30
Niger	0.50	0.52	0.78	-0.15	-2.80	0.48	0.30	0.22	-1.16	0.80	0.45	0.35
Rwanda	0.01	-0.07	0.02	0.20	0.92	-0.13	-0.05	0.23	0.84	0.04	-0.01	0.05
Senegal	-0.46	-0.08	0.08	0.20	0.70	-0.38	-0.86	-0.42	-0.25	-0.48	-0.42	-0.06
Sierra Leone	-0.08	-0.34	-0.23	0.23	0.41	0.09	-0.37	0.52	-0.59	-0.33	-0.03	-0.30
Tanzania	0.32	0.12	0.30	0.37	-0.39	0.06	0.02	0.45	0.23	0.25	0.25	-0.00
Uganda	0.12	0.03	0.21	0.21	1.01	0.12	0.14	0.14	-0.27	0.10	0.10	0.00
Zimbabwe	0.10	0.03	-0.08	-0.38	-0.81	-0.51	0.10	0.22	-0.19	-0.04	0.17	-0.21
EASTERN MEDITERRANEAN REGION												
Egypt	-0.07	0.32	0.02	-0.43	-0.21	-0.09	-0.09	0.01	0.13	-0.19	0.02	-0.21
Jordan	0.73	0.91	0.83	-0.10	-0.17	0.37	0.82	0.59	0.63	0.69	0.97	-0.28

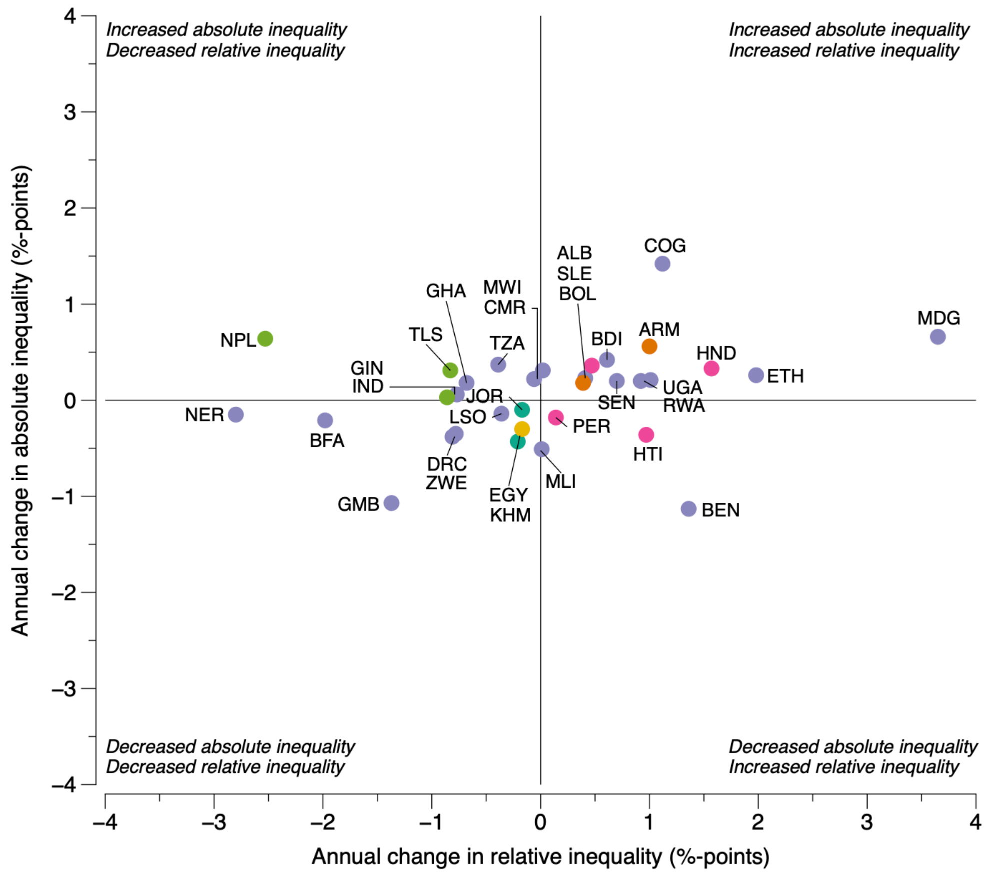
Q1, poorest; Q5, richest; E1, no education; E3, secondary+; DRC, Democratic Republic of the Congo. Values are AARC in percentage points.

Table 8.8. (continued)

		Wealth-related inequalities				Education-related inequalities				Residence-related inequalities		
Country	**Overall**	**Q1**	**Q5**	**SII**	**CIX**	**E1**	**E3**	**SII**	**CIX**	**Urban**	**Rural**	**Gap**
EUROPEAN REGION												
Albania	0.39	0.21	0.53	0.56	1.00	-	-	-	-	0.71	0.10	0.61
Armenia	-0.04	-0.22	-0.13	0.18	0.39	-	-	-	-	0.06	-0.20	0.26
AMERICAS REGION												
Bolivia	0.66	0.38	0.86	0.36	0.47	1.20	0.44	-1.00	-0.74	0.70	0.56	0.14
Haiti	0.27	0.19	-0.03	-0.36	0.97	0.09	0.21	0.14	0.26	0.17	0.34	-0.18
Honduras	0.02	0.03	0.27	0.33	1.57	0.10	0.10	0.15	1.44	0.07	-0.05	0.12
Peru	-0.56	-0.45	-0.78	-0.18	0.14	-0.24	-0.49	0.27	0.09	-0.61	-0.46	-0.15
SOUTHEAST ASIAN REGION												
India	0.37	0.22	0.45	0.03	-0.86	0.39	0.29	-0.19	-0.77	0.50	0.42	0.08
Nepal	0.58	0.27	0.94	0.64	-2.53	0.40	0.69	0.52	-0.51	0.49	0.42	0.07
Timor-Leste	0.14	-0.01	0.17	0.31	-0.83	-0.01	0.16	0.29	0.57	0.24	0.07	0.17
WESTERN PACIFIC REGION												
Cambodia	0.27	0.24	0.09	-0.30	-0.17	0.34	0.23	-0.24	0.24	0.34	0.25	0.09

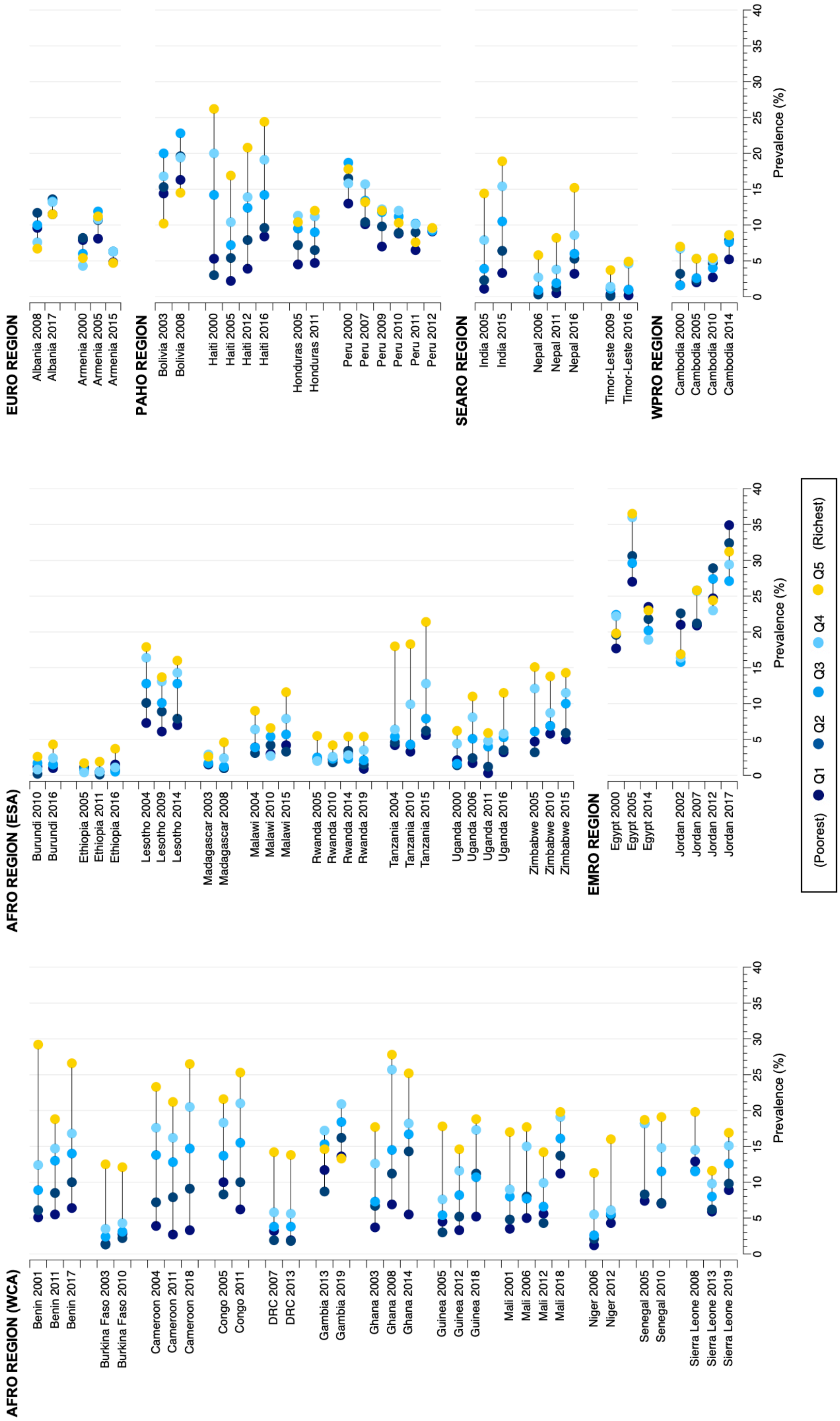
Q1, poorest; Q5, richest; E1, no education; E3, secondary+; DRC, Democratic Republic of the Congo. Values are AARC in percentage points.

Figure 8.9. Benchmarking trends in absolute (SII) and relative (CIX) wealth-related inequality in 33 LMICs.



BEN: Benin, BFA: Burkina Faso, BDI: Burundi, CMR: Cameroon, COG: Congo, DRC: Democratic Republic of the Congo, ETH: Ethiopia, GMB: Gambia, GHA: Ghana, GIN: Guinea, LSO: Lesotho, MDG: Madagascar, MWI: Malawi, MLI: Mali, NER: Niger, RWA: Rwanda, SEN: Senegal, SLE: Sierra Leone, TZA: Tanzania, UGA: Uganda, ZWE: Zimbabwe, EGY: Egypt, JOR: Jordan, ALB: Albania, ARM: Armenia, BOL: Bolivia, HTI: Haiti, HND: Honduras, PER: Peru, IND: India, NPL: Nepal, TLS: Timor-Leste, KHM: Cambodia.

Figure 8.10. Equiplots showing changes over time in concurrent overweight/obesity and anaemia among adult women by wealth quintile.



8.2.5.2. Changes over time in education-related inequalities

Of the 31 LMICs for which education-related inequalities could be measured, absolute inequalities increased in 19 and decreased in 12 countries (**Table 8.8**). In terms of relative inequality, a positive annual change in CIX was observed in 13 countries, whereas in 18, the trend in CIX was decreasing.

Equity improved according to absolute and relative indicators in Benin, Burkina Faso, Cameroon, the Democratic Republic of the Congo, Gambia, Guinea, Malawi, Mali, Senegal, Bolivia and India (**Figure 8.11**). Of these countries, the overall trend in concurrent overweight/obesity and anaemia was positive in all LMICs except from the Democratic Republic of the Congo and Senegal. Conversely, equity worsened in Congo, Ethiopia, Ghana, Madagascar, Rwanda, Tanzania, Egypt, Jordan, Haiti, Honduras, Peru and Timor-Leste. In these countries, the overall trend of DBM was increasing in ten countries, while decreasing in Egypt and Peru.

Equiplots displaying trends in intra-individual DBM by level of education are presented in **Figure 8.12.** Most countries showed a similar distribution of concurrent overweight/obesity and anaemia over the years, whereas in others such as Benin, Burkina Faso, Gambia, Senegal, Sierra Leone, Madagascar, Egypt, Bolivia, Honduras, Peru and Timor-Leste, the highest burden of DBM changed from one subgroup to another when comparing the earliest vs. the latest survey.

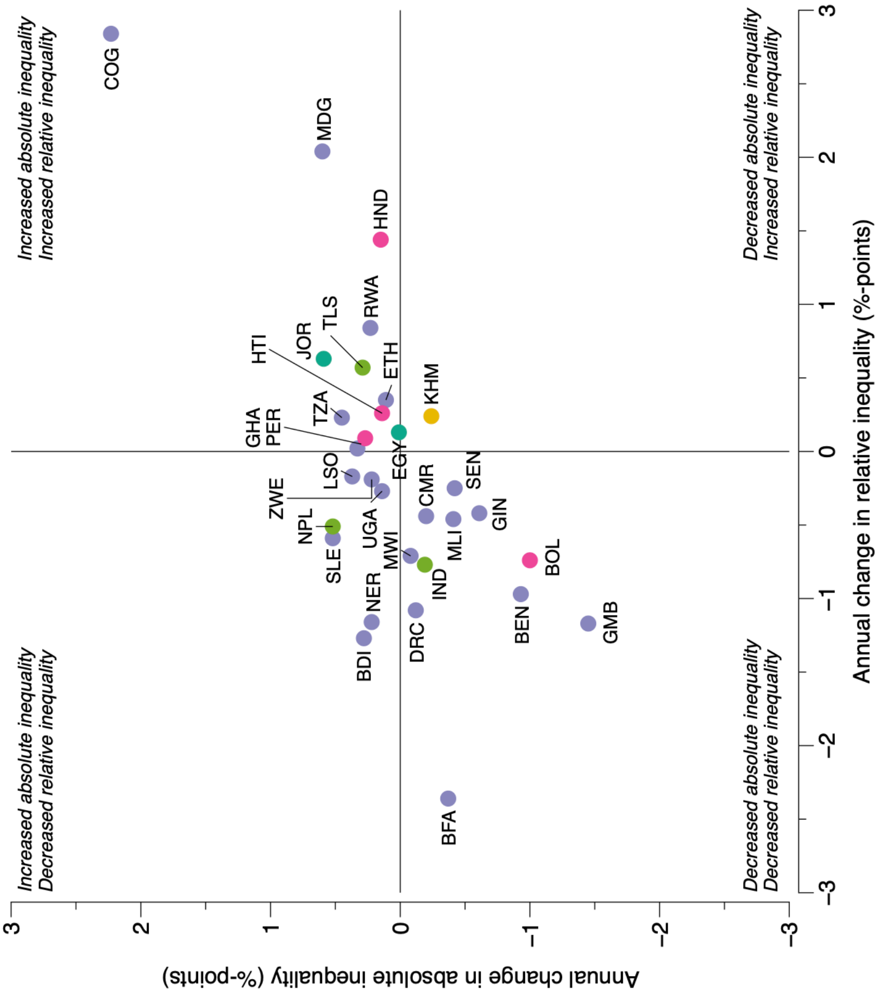
8.2.5.3. Changes over time in inequalities by area of residence

The annual change in inequality gaps between the prevalence in DBM in urban areas vs. rural areas was positive in 18 and negative in 15 countries (**Table 8.8**). However, in Cameroon, the Democratic Republic of the Congo, Lesotho, Tanzania and Uganda the AARC value was close to zero (<0.05 pp). Overall, 21 countries had an increase in prevalence of DBM in urban and rural areas; whereas Lesotho, Senegal, Sierra Leone and Peru presented negative AARC values for both areas of residence (**Table 8.8**).

In **Figure 8.13**, trends in the distribution of intra-individual DBM are displayed for women living in capital cities, other urban areas, and rural areas. The equiplots depict clear top inequality patterns, with the highest prevalence of DBM among women living in capital cities for the majority of African countries, particularly in the WCA subregion, although with a few exceptions. Countries in the Eastern Mediterranean and

European regions reveal important variations in the distribution of DBM over the past two decades.

Figure 8.11. Benchmarking trends in absolute (SII) and relative (CIX) education-related inequality in 31 LMICs.



BEN: Benin, BFA: Burkina Faso, BDI: Burundi, CMR: Cameroon, COG: Congo, DRC: Democratic Republic of the Congo, ETH: Ethiopia, GMB: Gambia, GHA: Ghana, GIN: Guinea, LSO: Lesotho, MDG: Madagascar, MWI: Malawi, MLI: Mali, NER: Niger, RWA: Rwanda, SEN: Senegal, SLE: Sierra Leone, TZA: Tanzania, UGA: Uganda, ZWE: Zimbabwe, EGY: Egypt, JOR: Jordan, ALB: Albania, ARM: Armenia, BOL: Bolivia, HTI: Haiti, HND: Honduras, PER: Peru, IND: India, NPL: Nepal, TLS: Timor-Leste, KHM: Cambodia.

Figure 8.12. Equiplots showing changes over time in concurrent overweight/obesity and anaemia among adult women by education level.

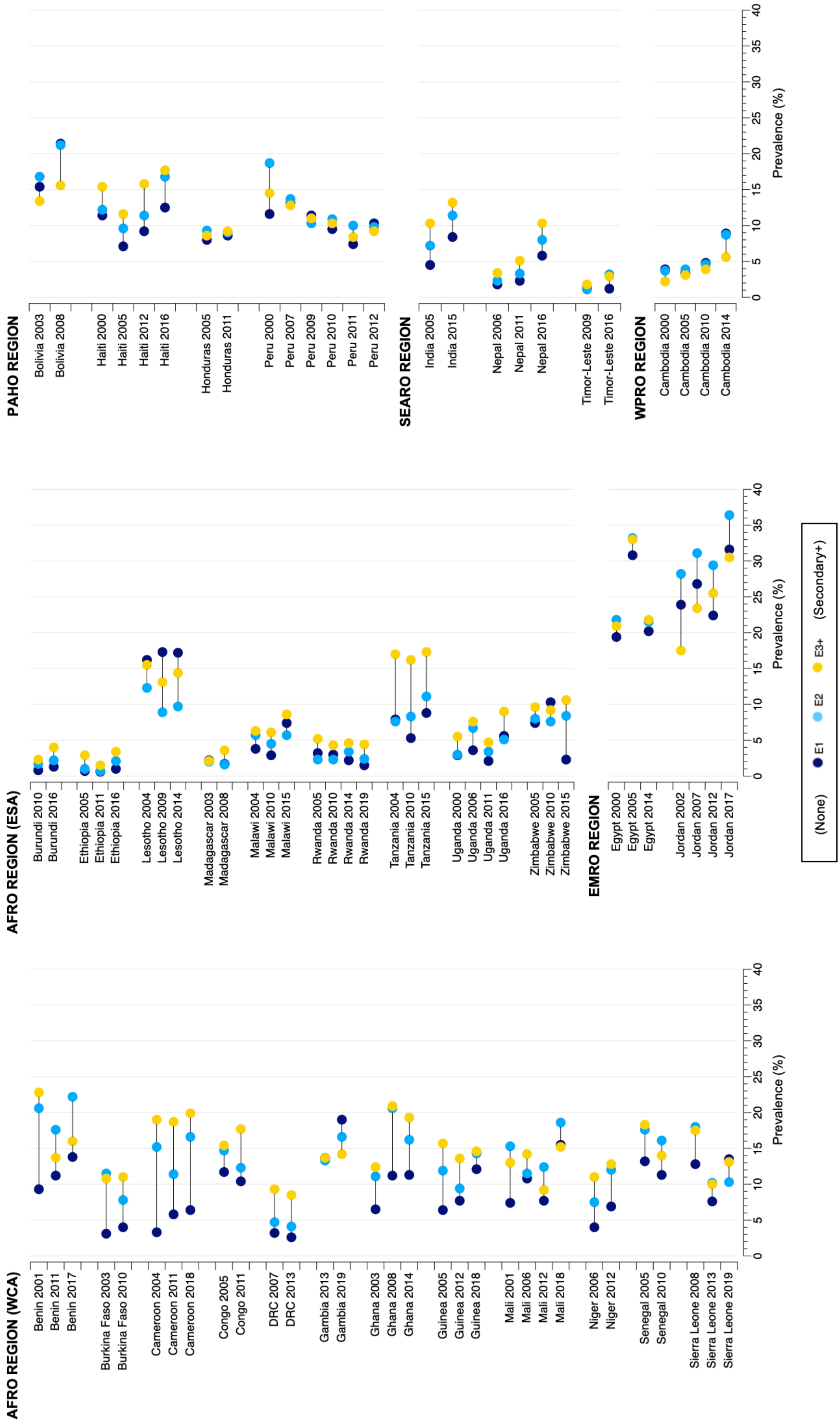
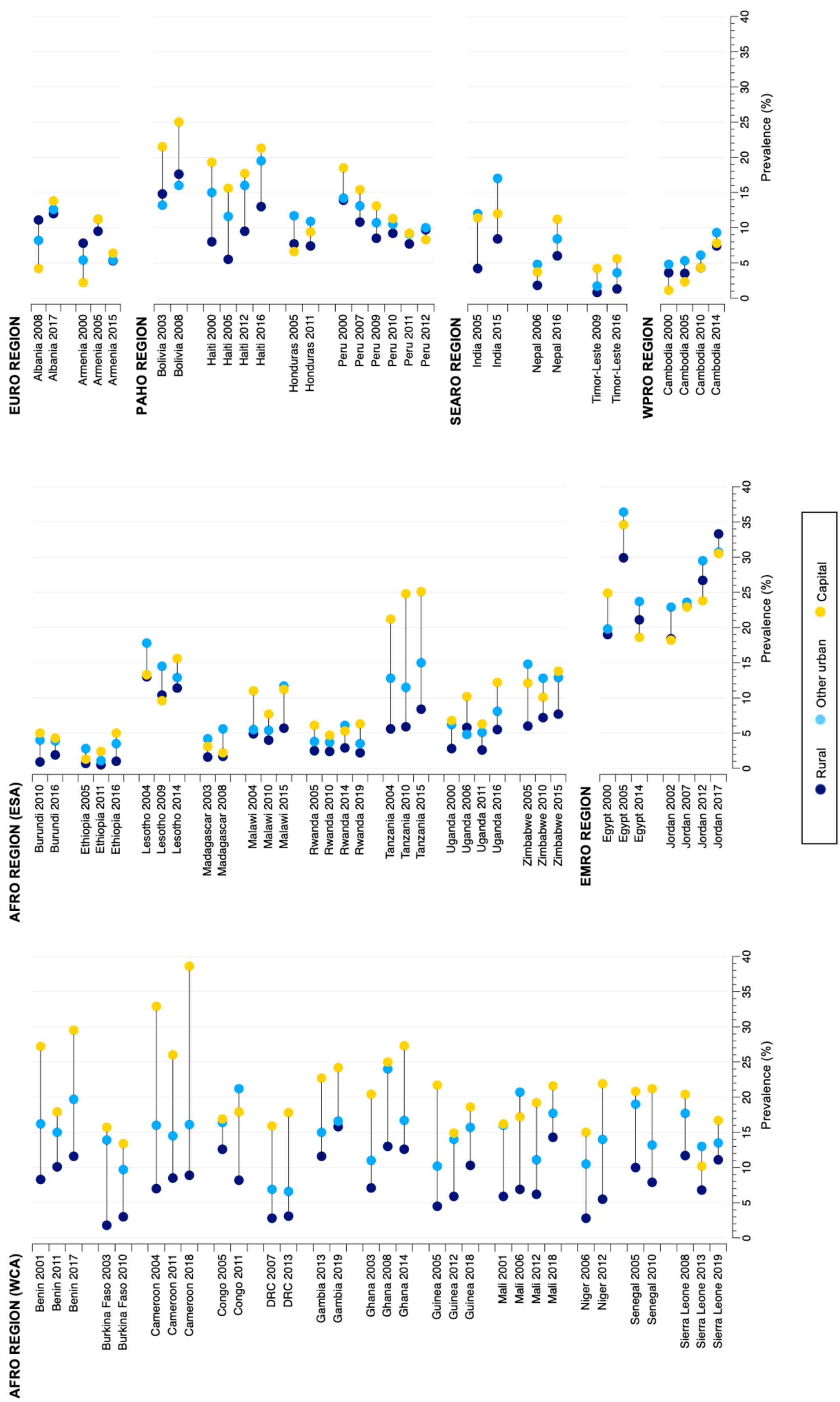


Figure 8.13. Equiplots showing changes over time in concurrent overweight/obesity and anaemia among adult women by area of residence.



8.3. Discussion

Using DHS data from 33 LMICs, which had at least two surveys with available anaemia and anthropometric data among adult women (20-49 years old), it was found that the prevalence of the intra-individual double burden of overweight/obesity and anaemia increased modestly at an annual rate of 0.17 pp (95% CI: 0.07, 0.27) from 2000 to 2019. Simultaneously, overweight/obesity increased at an annual rate of 0.73 pp (95% CI: 0.59, 0.86); while anaemia declined at -0.36 pp (95% CI: -0.60, -0.12) annually. Of the 33 LMICs included in the analysis, concurrent overweight/obesity and anaemia increased in 23, decreased in six, and was close to zero (AARC in the range 0.05 to -0.05) in four countries. Jordan experienced the largest increase in DBM (AARC=0.73 pp), while Peru experienced the largest decrease (AARC=-0.56 pp).

In Chapter 5 of this thesis, it was reported that over one in ten adult women living in 52 LMICs were simultaneously affected by overweight/obesity and anaemia, ranging from 1.7% in Ethiopia to 33.6% in Maldives (Irache et al., 2021). Previous studies identified in Chapter 2 also reported similar prevalence estimates of concurrent overweight/obesity and anaemia or specific micronutrient deficiencies among WRA in LMICs (Eckhardt et al., 2008; Conde & Monteiro, 2014; Freire et al., 2014; Kroker-Lobos et al., 2014; Gartner et al., 2014; Laillou et al., 2014; Ramirez-Zea et al., 2014; Sarmiento et al., 2014; Jones et al., 2016a; Traissac et al., 2016; Jones et al., 2017; Jones et al., 2018; Lee & Ryu et al., 2018; Engle-Stone et al., 2020; Varghese & Stein, 2019; Kushitor et al., 2020; Little et al., 2020; Rhodes et al., 2020; Sethi et al., 2020; Wegmüller et al., 2020; Williams et al., 2020).

Increasing DBM trends, in a context of declining or stagnant overall anaemia trends, suggest that the nutritional needs of women living with overweight/obesity are not necessarily been met, and/or that the current initiatives to reduce anaemia are not as effective among this population when compared to normal weight or underweight. This is further supported by findings presented in this study, whereby reductions in anaemia only (women living with normal weight or underweight) are observed together with increases or stagnant rates in DBM for the same country (e.g., Cameroon, Congo, DRC, Gambia, Ghana, Guinea, Malawi, Rwanda, Tanzania, Uganda, Zimbabwe, Haiti, or Cambodia). Peru is an exception of this, with an apparent downward trend in anaemia across all BMI groups, which might be the result of government-led initiatives to address malnutrition among vulnerable groups, and its antipoverty policies (MIDIS, 2014; Huicho et al., 2016; Berky et al., 2020).

The limited effect of dietary changes or treatments to improve micronutrient malnutrition (e.g., iron deficiency) among different population groups living with overweight/obesity has been previously documented (Baumgartner et al., 2013; Cepeda-Lopez et al., 2015; Camaschella et al., 2020). The positive effect of food fortification on anaemia, iron deficiency or other micronutrient deficiencies has also been investigated among WRA and children, but results are rarely presented by BMI groups (Bhutta et al., 2013; Das et al., 2013; Tam et al., 2020). It has also been hypothesised that iron supplementation might have harmful consequences among individuals living with obesity (El-Mallah et al., 2021). Defining micronutrient deficiencies as a component of undernutrition, might undermine the fact that these are also prevalent in normal-weight and overweight populations. Further, the nutrition transition that LMICs are undergoing, characterised by the availability and affordability of ultra-processed foods, which are both energy-dense and nutrient-poor, are driving the rapid rise in overweight/obesity rates, which might also be contributing to slowing the progress in reducing anaemia and/or other forms of micronutrient deficiencies (Popkin et al., 2012; Monteiro et al., 2013; Osendarp et al., 2020; Popkin et al., 2020; Development Initiatives, 2021). Empirical evidence exists from LMICs and high-income countries that support an association between consumption of ultra-processed foods and risk of overweight/obesity and nutrition-related NCDs (Louzada et al., 2015a; Mendonça et al., 2016; Juul et al., 2018; Beslay et al., 2020; Canhada et al., 2020; Matos et al., 2021), and inadequate intake of micronutrients (Louzada et al., 2015b; Martínez-Steele et al., 2017; Louzada et al., 2018; Falcão et al., 2019). Concurrently, overweight/obesity can also lead to iron deficiency and/or anaemia through different physiological mechanisms (Nemeth et al., 2004; Zhao et al., 2015; Cepeda-Lopez, 2010). Thus, rapid increases in overweight/obesity across LMICs might exacerbate the DBM. In this study, of the 33 countries analysed, all but one country (Senegal) had an upward trend in overweight/obesity. Of these, 26/32 had an upward trend in concurrent overweight/obesity and anaemia, with 22 countries presenting an annual increase above 0.10 pp.

Important differences in DBM trends are reported in this chapter across and within the different WHO regions. In the Eastern Mediterranean and Southeast Asian regions, both separate forms of malnutrition increased over the past two decades, as opposed to the other regions where overweight/obesity increased, but overall anaemia decreased or remained stagnant in the European region. In these two regions, the annual change in DBM in pp was also higher than in the other regions. Using the World Bank Income classification, low-income and lower-middle income countries, where the nutrition and epidemiological transitions are still ongoing, showed a positive and significant increase trend in DBM over time. In upper-middle-income countries, the trend was also positive but not significant. This would be in line with previous research stating that the DBM was currently more present in the lowest quartile GDP/capita countries, where diets and food systems are rapidly evolving from more traditional towards westernised patterns, causing energy imbalances (Popkin et al., 2020). Newly developed typologies that classify countries according to food system types (Marshall et al., 2021), might help to better elucidate links between food systems and changes in DBM prevalence, than the latter classification. For example, of note is the variability in results observed in the African region, where the DBM increased almost three times faster in countries located in the WCA, when compared to the ESA, over the past two decades. These countries also had important top inequality patterns by area of residence, with significant higher prevalence estimates in capital cities (although the DBM seemed to be increasing faster in rural areas). According to the Marshall et al. (2021) classification countries in the WCA are in the informal and expanding food system category; whereas the ESA countries included in this study are in the rural and traditional food system category.

The trend analysis by sociodemographic characteristics yielded increases in DBM across all subgroups, but particularly among the three middle wealth groups, women with no education and those living in capital cities or rural areas. These observed stratified trends seem to emulate those observed for overweight/obesity in LMICs, whereby the burden has been rising more rapidly among capital city residents and women with no education (Jiwani et al., 2019; Jiwani et al., 2020); but also appear to be shifting towards rural areas in certain regions (NCD-RisC, 2019). Despite these trends, the magnitude of the DBM among adult women remains concentrated largely among the richest groups, higher education levels and urban areas (Gartner et al., 2014; Jones et al., 2016a; Kushitor et al., 2020; Sethi et al., 2020; Irache et al., 2021), emulating the current burden of overweight/obesity (Templin et al., 2019). Only for a few countries mostly located within the Eastern and Mediterranean and European regions, changes in this distribution occurred over the past two decades by the three sociodemographic characteristics. Subsequently, trends in inequality measures yielded mixed results for the different countries. Some also had an increase in absolute inequality and a decrease in relative inequality, or viceversa, which is not necessarily contradictory, given that the distribution of DBM by household wealth or education level was not linear for every country (Barros & Victora, 2013; Restrepo-Mendez et al., 2015).

This study represents the first comprehensive trends analysis of the magnitude and inequalities in the intra-individual double burden of overweight/obesity and anaemia among adult women (20-49 years old) living in 33 LMICs across different WHO regions, over the past two decades. This is a strength of the study, filling a gap in research and contributing to the growing literature on the DBM from LMICs. However, the current analysis should be cautiously interpreted for different reasons. First, anaemia is multifactorial, and DHS does not provide sufficient information about these factors within each country. Previous studies have reported that for WRA, iron deficiency remains the major contributing factor for anaemia, but varies according to infection burden of a given setting (Wirth et al., 2017). According to the latter study, the proportion of women living with anaemia, with iron deficiency is 35.1%, 65.3% and 71.0% in countries with a high, medium and low infection burden, respectively (Wirth et al., 2017). In despite of this, anaemia is normally used as a proxy for micronutrient deficiencies, when objective data on specific micronutrients is not available (Cameron & Neufel, 2011; SPRING, 2017; Development Initiatives, 2021). Similarly, BMI does not accurately reflect body fat composition or the changes that occur with age, which can lead to misclassification errors (Rothman et al., 2008). Nevertheless, DHS, which are large-scale household-based nationally representative surveys conducted across LMICs, are challenged by extensive data collection, and therefore, do not include body composition variables. Likewise, micronutrient deficiencies are normally not included in these surveys neither, due to the added economic value and arduous process; but efforts are underway to incorporate these in some DHS surveys (Rhodes et al., 2019). Second, the lack of comprehensive data remains an important limitation. On the one hand, of the 51 countries with a DHS with available anthropometric and anaemia data among adult women (Irache et al., 2021), only 33 had more than one survey, and therefore, included to this study. On the other hand, only eight countries located in the African (n for WCA=6; n for ESA=1) and Eastern Mediterranean (n=1) regions had a survey in the last five years. Moreover, data was mainly from the African region, and thus, other regions included in this study are underrepresented. For example, the Western Pacific region only had one country (Cambodia); whereas the Eastern Mediterranean, European, Americas and Southeast Asian regions had two, two, four and three, respectively. Third, given the variability in DBM trends observed for the different LMICs, conclusions at the global level should be drawn with caution. Fourth, for some countries, stratified trend estimates by education level could not be calculated because sample sizes were below 25 participants (Croft et al., 2018).

In conclusion, the analysis of trends and inequalities in the intra-individual DBM of adult women disclosed in this chapter suggests a modest increase in concurrent overweight/obesity and anaemia in most LMICs included in this study, which have happened in parallel with overall reductions in anaemia and increases in overweight/obesity. Further, a positive finding is that rates of anaemia among women living with underweight and normal weight seem to have dropped between 2000 and 2019 for a number of countries. Yet, the global target of halting the prevalence of anaemia among WRA by 2025 will not be achieved unless all women are targeted, especially in the context of an upward trend in overweight/obesity. The consequences of the double burden of overweight/obesity and anaemia are yet still to be fully determined and understood; however, micronutrient malnutrition could potentially increase the risk and severity of NCDs for which overweight/obesity is already a risk factor, through different pathways (Frei et al., 1989; Gaziano et al., 1992; Sprietsma & Schitemaker, 1994; Thompson & Godin, 1995; Chausmer, 1998; Madamanchi et al., 2005; Branca et al., 2019; Bruins et al., 2019). Reducing anaemia in women living with overweight/obesity might prove particularly challenging due to obesity-mediated inflammation which might impede iron absorption (or other micronutrients) from the diet and reduce country-level efforts to control iron deficiency in these groups (Nemeth et al., 2004; Bekri et al., 2006; Zimmermann et al., 2008; Cepeda-Lopez et al., 2010; Mujica-Coopman et al., 2015; Zhao et al., 2015). Likewise, anaemia, as well as overweight/obesity, could lead to poor exercise capacity, contributing further to the development of both conditions. Studies investigating the effectiveness of nutrition interventions that have a focus on anaemia should consider stratifying results by BMI group to better understand whether current interventions work among women living with overweight/obesity. There is also a need to identify the factors contributing to anaemia in each setting, so that interventions target context-specific needs of each LMIC. Moreover, in this context, prevention and management early on of overweight/obesity in vulnerable populations might be crucial to address the double burden. Women who are already living with overweight/obesity might benefit from periodical micronutrient deficiencies testing, to prevent the associated consequences (including intergenerational) of both conditions, particularly in LMICs where the DBM prevalence is high. Lastly, this study highlighted the importance of good diet quality for all women, as such a shift towards double-duty actions is warranted.

8.4. Chapter summary

In this chapter, the results on the trends in the magnitude and inequalities of the double burden of overweight/obesity and anaemia at the individual level among adult women (20-49 years olds) were presented and discussed.

KEY FINDINGS

- Overall, data from the 33 LMICs included indicated that concurrent overweight/obesity and anaemia increased modestly at an annual rate of 0.17 pp from 2000 to 2019.
- The DBM trend was upward in 26 countries and downward in seven, ranging from 0.73 in Jordan to -0.56 in Peru.
- The trend observed in DBM occurred in parallel with overall increases in overweight/obesity and reductions in anaemia.
- The trend analysis by sociodemographic characteristics yielded increases in DBM across all subgroups, but particularly among the three middle wealth groups, women with no education and those living in capital cities or rural areas.
- Trends in inequality measures were mixed for the different LMICs; but seemed to increase in more than 50% of countries.
- Differences in findings were observed across and within WHO regions.

The next chapter presents the key findings of this thesis, an overall discussion and the concluding remarks.

CHAPTER 9

Overall discussion and conclusions

9.1. Chapter overview

The aim of this thesis was to understand the epidemiology of the double burden of overweight/obesity and anaemia at the three levels among adult women, adolescent girls and children living in LMICs, in order to fill the existent gap in research in this area and provide evidence that may be used by policy makers to improve nutrition outcomes and address the DBM. The previous literature on the DBM is relatively rich for the coexistence of overweight/obesity and stunting. However, other forms of DBM, including the double burden of overweight/obesity and anaemia have been less investigated. The overview of the evidence conducted in Chapter 2 revealed a paucity of studies with important gaps in research on this subject, particularly at the individual and household levels. This thesis also presents the first trend analysis on the intra-individual double burden of overweight/obesity and anaemia among adult women using large nationally representative data from 33 LMICs, which was one of the gaps in research identified.

This thesis sought to answer three main research questions relating to the DBM:

1) What is the magnitude of the double burden of overweight/obesity and anaemia at the three levels (i.e., population, household and individual) among adult women, adolescent girls and children living in LMICs? (Chapter 5 and 6)

2) How is the double burden of overweight/obesity and anaemia at the individual and household levels distributed across different population subgroups (i.e., by wealth quintiles, education levels, area of residence and sex)? (Chapter 5, 6 and 7)

3) How is the magnitude and inequalities of the double burden of overweight/ obesity and anaemia at the individual level changing over time? (Chapter 8)

This final chapter summarises the key findings of this thesis, discusses the strengths and limitations and highlights future implications for research and relevance for policy.

9.2. Summary of key findings

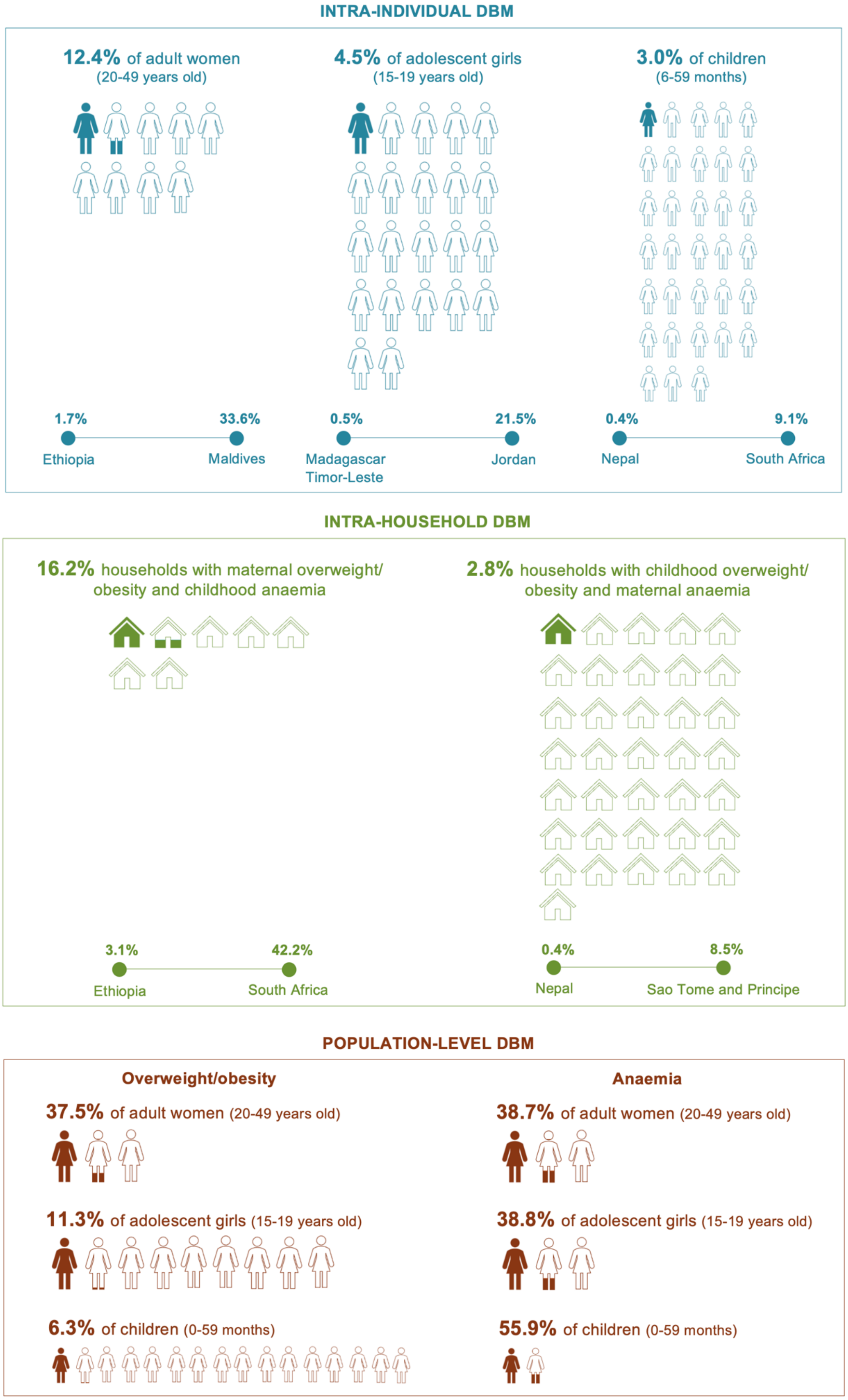
9.2.1. Objective 1: Magnitude of the DBM

Chapter 5 reported findings on the magnitude of the double burden of overweight/obesity and anaemia at the individual level (i.e., concurrent overweight/obesity and anaemia) among adult women (20-49 years old), adolescent girls (15-19 years old) and children (6-59 months) living in 52 LMICs. The overall pooled prevalence of the intra-individual DBM was 12.4%, 4.5% and 3.0% for adult women, adolescent girls and children, respectively (**Figure 9.1**). These values are slightly higher than those reported in earlier studies including multiple countries (n=16 and 21) from different WHO regions, identified in Chapter 2 (Engle-Stone et al., 2020; Williams et al., 2020). Nevertheless, these studies also found important variations in the DBM prevalence by country, as highlighted in this thesis. The proportion of concurrent overweight/obesity and anaemia ranged from 1.7% in Ethiopia to 33.6% in Maldives for adult women; 0.5% in Madagascar and Timor-Leste to 21.5% in Jordan for adolescent girls; and 0.4% in Nepal to 9.1% in South Africa for children. Variations were also reported in this thesis by WHO region. The highest and lowest overall regional prevalence of intra-individual DBM estimate was found in the Eastern Mediterranean (23.8%) and African (11.1%) regions for adult women; Eastern Mediterranean (11.8%) and European (2.5%) regions for adolescent girls; and European (3.8%) and Southeast Asian (1.2%) regions for children, respectively. Another interesting finding is that while the prevalence of DBM seemed to be significantly more prevalent among adult women, in 14 countries, the prevalence among children was higher than that of adolescent girls; and in four countries (Rwanda, Burundi, Ethiopia and Timor-Leste) the prevalence was small (<5%) for the three age groups.

Prevalence estimates of the DBM at the population level (i.e., separate estimates for overweight/obesity and anaemia) were also reported in Chapter 5 for every country and WHO region, for the three age groups. The overall pooled prevalence of overweight/obesity was 37.5%, 11.3% and 6.3% among adult women, adolescent girls and children, respectively (**Figure 9.1**). The overall pooled prevalence of anaemia was 38.7%, 38.8% and 55.9% among adult women, adolescent girls and children, respectively. These values are similar to those reported earlier using nationally representative data (Development Initiatives, 2021), and indicate that differences in DBM estimates at the individual level among adult women and adolescent girls are primarily driven by a higher prevalence of overweight/obesity among those aged >19 years old, as both groups appear to have a similar burden of anaemia. Likewise, in the majority of countries, children had the lowest prevalence of intra-individual DBM, with the lowest overall pooled prevalence of overweight/obesity, but highest pooled prevalence of anaemia.

Chapter 6 presented findings on the magnitude of the double burden of overweight/obesity and anaemia at the household level using data from mothers (15-49 years old) and their children (0-59 months) living in 49 LMICs. The overall pooled prevalence of total intra-household DBM was 17.2%: 16.2% for maternal overweight/obesity and childhood anaemia and 2.8% for maternal anaemia and childhood overweight/obesity (**Figure 9.1**). As evidenced by findings shown in Chapter 2, there was a dearth of studies investigating the magnitude of the intra-household DBM, defined as maternal overweight/obesity and childhood anaemia or maternal anaemia and childhood overweight/obesity, before conducting this PhD thesis. A total of six studies were identified through PubMed, from five countries (Tunisia, Ecuador, Bolivia, Bangladesh and India), reporting different burdens of the coexistence of overweight/obesity and anaemia within the household (Freire et al., 2014; Jones et al., 2018; Sassi et al., 2019; Mamun & Mascie-Taylor, 2019; Varghese & Stein, 2019; Kumar et al., 2021). Likewise, important variations were observed across and within countries and WHO regions in this thesis. The prevalence of maternal overweight/obesity and childhood anaemia ranged from 3.1% in Ethiopia to 42.2% in South Africa; while the prevalence of maternal anaemia and childhood overweight/obesity ranged from 0.4% in Nepal to 8.5% in Sao Tome and Principe. By WHO region, the highest and lowest overall regional estimate of intra-household DBM was found in the Eastern Mediterranean (24.1%) and European (12.1%) regions for maternal overweight/obesity and childhood anaemia; and in the European (4.4%) and Southeast Asian (1.7%) regions for maternal anaemia and childhood overweight/obesity, respectively. These results highlight higher prevalence estimates for the form maternal overweight/obesity and childhood anaemia, when compared to maternal anaemia and childhood overweight/obesity, which are in alignment with previous studies comparing both forms of intra-household DBM (Sassi et al., 2019; Varghese & Stein, 2019). These observations are also comparable to studies investigating the intra-household DBM, using anthropometric data only (i.e., coexistence of overweight/obesity and stunting), whereby the highest prevalence was observed for the combination of undernutrition among children and overweight/obesity among mothers (Popkin et al., 2020; Bliznashka et al., 2021).

Figure 9.1. Infographic showing key findings on the magnitude of the DBM.



9.2.2. Objective 2: Inequalities in the distribution of the DBM

The distribution of the double burden of overweight/obesity and anaemia was calculated at the household and individual levels, by different sociodemographic characteristics including household wealth, education level, area of residence and sex. Inequalities were quantified using different measures (i.e., complex and simple). While there were a large number of studies identified in Chapter 2 investigating the distribution of the DBM, most articles focused on overweight/obesity and anaemia separately (i.e., the population-level DBM). The available evidence for the intra-individual DBM (Gartner et al., 2014; Ramirez-Zea et al., 2014; Jones et al., 2016a; Traissac et al., 2016; Zou et al., 2016; Jones et al., 2017; Jones et al., 2018; Lee & Ryu, 2018; Engle-Stone et al., 2020; Williams et al., 2020; Acharya et al., 2020; Kushitor et al., 2020; Little et al., 2020; Rhodes et al., 2020; Sethi et al., 2020) and intra-household DBM (Jones et al., 2018; Mamun & Mascie-Taylor, 2019; Kumar et al., 2021), either explored the association between sociodemographic factors and DBM outcomes or, to a lesser extent, provided stratified estimates.

In this thesis, Chapter 5 examined the distribution of the intra-individual double burden of overweight/obesity and anaemia among adult women (20-49 years old), adolescent girls (15-19 years old) and children (6-59 months) living in 52 LMICs. Overall, the highest DBM prevalence was found in the highest household wealth groups, highest maternal education levels and urban residents among adult women and adolescent girls. Among children, the overall distribution in DBM seemed to differ, with overall small differences across population subgroups, by household wealth, maternal education levels and area of residence, but slightly higher estimates among boys than girls. Simple measures of inequality (i.e., gaps) calculated in Chapter 5, showed important differences in the burden of DBM across the most extreme population subgroups, particularly among adult women. For this population, inequality gaps as wide as 10 pp or larger, were identified in 20 countries by household wealth, eight by education level and five by area of residence. Among adolescent girls, the largest inequality gaps were found in Togo by household wealth (15.3 pp). Inequality gaps among children were overall small (<3.0 pp), although with a few exceptions.

Chapter 6 displayed results for the distribution of the intra-household double burden of overweight/obesity and anaemia in 49 LMICs. Overall, the highest prevalence was found in the highest household wealth groups, highest maternal education levels and in urban areas for maternal overweight/obesity and childhood anaemia. For the form maternal anaemia and childhood overweight/obesity, the difference in DBM proportion across population subgroups was minimal for the three sociodemographic groups. Large inequality gaps were identified, especially for maternal overweight/obesity and childhood anaemia, with gaps >10 pp in 27 countries by household wealth, 15 by maternal education level, and 21 by area of residence. For maternal anaemia and childhood overweight/obesity, inequality gaps were <5 pp by the three sociodemographic characteristics in all but one instance: Mozambique by maternal education level (-6.8 pp).

In both chapters, the analyses conducted showed differences by WHO regions. Similarly, mixed results were observed in Chapter 2 when describing the evidence from previous studies, which seemed to vary across and within WHO regions. This calls for caution when generalising results at the global level. A recent study assessing inequalities in the intra-household DBM, defined as maternal overweight/obesity and childhood stunting, found that the probability of DBM was higher among richer households in poorer LMICs and poorer households in richer LMICs (Seferidi et al., 2022), emulating the distribution of overweight/obesity (Templin et al., 2019). This is not surprising, since increases in DBM have been attributed to increases in overweight/obesity (Popkin et al., 2020). Therefore, this could have explained differences in the distribution of the double burden of overweight/obesity and anaemia observed in this thesis. For example, in Peru, an upper-middle-income country, the prevalence was highest among those in the lowest household wealth groups (gap= -10.8 pp) for maternal overweight/obesity and childhood anaemia.

Further, simple measures of inequality, although easy to compute and thus, widely used, have been criticised in the past for not taking into account the whole distribution of a population sample (e.g., the middle groups) (Barros & Victora, 2013; Mujica & Victora, 2019). The latter method assumes that the lowest and highest prevalence correspond with the highest and lowest quintile or education level, which is not always the case. To counteract this limitation, the SII, a complex measure of inequality, was calculated to quantify wealth and education-related inequalities in the intra-individual and intra-household DBM, and findings were presented in Chapter 7. Overall, these additional analyses showed similar findings to those reported in Chapter 5 and Chapter 6. Some inconsistencies were observed for the intra-individual DBM among children and for maternal anaemia and childhood overweight/obesity, for which the highest and lowest burden of DBM was often found in the middle groups.

9.2.3. Objective 3: Trends in the magnitude and inequalities of the DBM

Chapter 8 focused on adult women (20-49 years old), for whom the burden of DBM was highest, to document trends in the magnitude and inequalities of the intra-individual double burden of overweight/obesity and anaemia. While there is a large body of evidence investigating trends in the magnitude of separate forms of malnutrition, the overview of the evidence preceding this thesis (Chapter 2) did not identify any paper examining changes over time in the coexistence of overweight/obesity and anaemia at the individual or household levels. To this end, Chapter 8 is relevant and timely in the wider context of the global nutrition goals, as it provides quantitative evidence on how both forms of malnutrition have coexisted over time within individuals, which might be used to guide the development of context-specific strategies that tackle the DBM more efficiently.

The analysis conducted among adult women (20-49 years old) living in 33 LMICs yielded a modest increase in the co-occurrence of overweight/obesity and anaemia (AARC=0.17 pp); an increase in overweight/obesity (AARC= 0.73 pp); and a decline in anaemia (AARC= -0.36 pp) over the period 2000-2019. Overall, the DBM increased in 23 LMICs, decreased in six, and remained stagnant in four. The largest rise in DBM prevalence was observed in Jordan (AARC=0.73 pp), while the largest decline occurred in Peru (AARC= -0.56 pp). Additional analyses performed in this chapter showed reductions in the proportion of women living with anaemia only (not overweight/obesity), in parallel with an upward or stagnant trend in DBM in a large number of countries. The latter could indicate that the nutritional needs of women living with overweight/obesity are not necessarily been met. Alternatively, initiatives currently in place to reduce anaemia might not be as effective among women living with overweight/obesity.

Further, although prevalence estimates in DBM among adult women were higher among those in the highest household wealth groups, higher education levels and in urban areas, the stratified trend analyses performed in Chapter 8 suggest that the DBM is increasing faster among the three middle wealth groups, women with no education and those living in capital cities or rural areas. Trends in absolute and relative inequality measures yielded mixed results, with approximately 60% and 50% of LMICs presenting increases in absolute and relative inequalities, respectively, by wealth and education subgroups. Likewise, the annual change in inequality gaps between the prevalence in DBM in urban areas vs. rural areas was positive in 55% of countries; although close to zero in five African countries.

9.3. Original contribution to knowledge of this PhD thesis

This thesis represents an important contribution to the literature on the magnitude of the DBM, for which the coexistence of overweight/obesity and anaemia, particularly at the individual and household levels, had only been investigated in a limited number of studies. This is evidenced by the overview undertaken for this PhD thesis (see Chapter 2) and further supported by published evidence (Davis et al., 2020). To date, the most comprehensive analysis of the DBM, which was published in The Lancet as part of the *Lancet Series on the Double Burden of Malnutrition*, only included anthropometric data (Popkin et al., 2020). This is an important limitation, since excluding micronutrient deficiencies from the DBM narrative directly translates in an underestimation of the full extent of malnutrition globally, as well as its consequences (Osendarp et al., 2020). Counting micronutrient deficiencies in the DBM estimates is of utmost importance to support the development of programmes and policies that target all forms of malnutrition to accelerate progress towards achieving the 2025 global nutrition targets, as well as the 2030 sustainable development goals agenda. In this context, this thesis aimed to answer these gaps identified in research, by providing reliable estimates on the double burden of overweight/obesity and anaemia, overall (for every country and by WHO regions) and by sociodemographic characteristics to identify population subgroups within LMICs who are most at risk of developing the DBM at the household or individual levels. Lastly, to the best of the PhD candidate's knowledge, this thesis encloses the first trend analysis of the magnitude and inequalities of the double burden of overweight/obesity and anaemia at the individual level among adult women (20-49 years).

9.4. Overall methodological considerations

To address the research questions proposed in this thesis, three main descriptive quantitative studies were performed. The specific strengths and limitations in relation to each research question were discussed, and are highlighted, in Chapter 5, 6, 7 and 8. This section elaborates more broadly on the strengths and limitations of the overall body of research and analyses conducted, and highlights issues to take into account when interpreting the findings arising from this thesis.

9.4.1. Availability of data to investigate the double burden of overweight/obesity and anaemia at the different levels

Data from the Demographic and Health Surveys (DHS) were used for all the analyses. This is mainly a strength, but also a limitation of this study. The DHS are internationally comparable, nationally representative household-based surveys, that collect data using standardised questionnaires and procedures (Croft et al., 2018). DHS are also characterised by high response rates, and data from a total of 825,769 adult women (1,128,815 for the trend analysis), 192,631 adolescent girls, 391,963 children and 311,604 households (encompassing mothers and their children under-5) were analysed for this thesis.

In order to be able to quantify the double burden of overweight/obesity and anaemia at the individual and household levels, both, anthropometric and anaemia data must be available for the population of interest within the same survey. In Chapter 4, this issue was discussed, and it was reported that while anthropometric data was available for WRA and/or children under-5 in 80 LMICs; only 52 countries (51 for WRA) had at least one survey with anthropometric and anaemia data. Likewise, the analysis at the household level was restricted to 48 LMICs. The number of countries with more than one dataset with available anthropometric and anaemia data among adult women for the trend analysis was lowered to 33 LMICs: 21 from the African region, 2 from the Eastern Mediterranean region, 2 from the European region, 4 from the Americas region, 3 from the Southeast Asian region and 1 from the Western Pacific region. Moreover, before conducting the analyses, other databases were searched, including the Multiple Indicator Cluster Surveys (MICS) and the World Bank webpage; however, suitable data to answer the thesis research questions were not found.

Another strength of using DHS data, besides large sample sizes, is that data on a variety of sociodemographic characteristics are collected, which allowed to stratify estimates by household wealth, education level, area of residence and sex; and thus, identify population subgroups who are at a higher risk of developing both forms of malnutrition within individual countries. Other factors available in DHS that were not included in this thesis, but that could potentially be used to explore the distribution or association with the DBM in future studies include ethnicity, religion, states/regions, occupation, and social capital, among others. Some of these factors have already been investigated for the DBM at the individual level (Gartner et al., 2014; Ramirez-Zea et al., 2014; Kushitor et al., 2020; Little et al., 2020) and household level (Mamun & Mascie-Taylor, 2019; Sassi et al., 2019; Kumar et al., 2021); however, the evidence comes overwhelmingly from studies investigating the DBM at the population level, as mentioned in Chapter 2. Stratifying intra-individual or intra-household DBM estimates by states or regions might be particularly relevant for policy making, to be able to identify differences in prevalence within countries. In this thesis, for Chapter 8, the magnitude of the intra-individual DBM among adult women was also calculated for capital cities, which adds a level of granularity to the analysis performed.

A limitation of DHS is the lack of dietary data, particularly among WRA, which has been described as a “major data gap” (The DHS Program, 2019b). Poor diet has been identified as a common driver of undernutrition and overweight/obesity (Hawkes et al., 2020). Studies conducted in individual LMICs using data from dietary surveys found that a high consumption of ultra-processed foods is associated with an increase in overweight/obesity, lower micronutrient intake, micronutrient deficiencies in children, lower length-for-age z-scores, and the coexistence of child stunting and maternal overweight (Anderson et al., 2008; Lander et al., 2010; Aitsi-Selmi, 2015; Louzada et al., 2015a; Louzada et al., 2015b; Pries et al., 2019). Yet, to the best of the PhD candidate’s knowledge, whether a high intake of ultra-processed foods is associated with the co-occurrence of overweight/obesity and anaemia at the individual or household levels remains unknown. The good news is that for round 8 of the DHS questionnaires (DHS-8), additional nutrition indicators have been added: minimum dietary diversity for women and questions on sugary and unhealthy foods for children and women (The DHS Program, 2019c). These questionnaires started to be used in surveys with fieldwork in late 2020, and as soon as data is released, this would allow to conduct analyses that address some of the current gaps in research.

9.4.2. Lack of consensus on DBM definitions

The WHO refers to the DBM as “the coexistence of undernutrition along with overweight, obesity or diet-related NCDs, within individuals, households and populations, and across the life-course” (WHO, 2017a). This definition is broad and lacks specificity with regards to guidance on how to operationalise the measurement of the DBM, which has been argued before (Bates et al., 2017; Davis et al., 2020; Scrinis, 2020). As a result, multiple operational definitions of the DBM exist and are currently in use in the literature. A recent review identified 623 definitions in 239 articles: overweight/obesity and thinness/wasting/underweight (n=289 occurrences), overweight/obesity and stunting (n=161), overweight/obesity and anaemia (n=74), overweight/obesity and at least one micronutrient deficiency (n=73), and other (n=26) (Davis et al., 2020). This is a major challenge when investigating and interpreting DBM data, as using different definitions and indicators of assessment can result in differing global estimates of DBM prevalence; which in turn, can have great implications for theory, policy development, programme planning, monitoring of the

DBM, and ultimately, the overall health of populations affected by malnutrition (Bates et al., 2017).

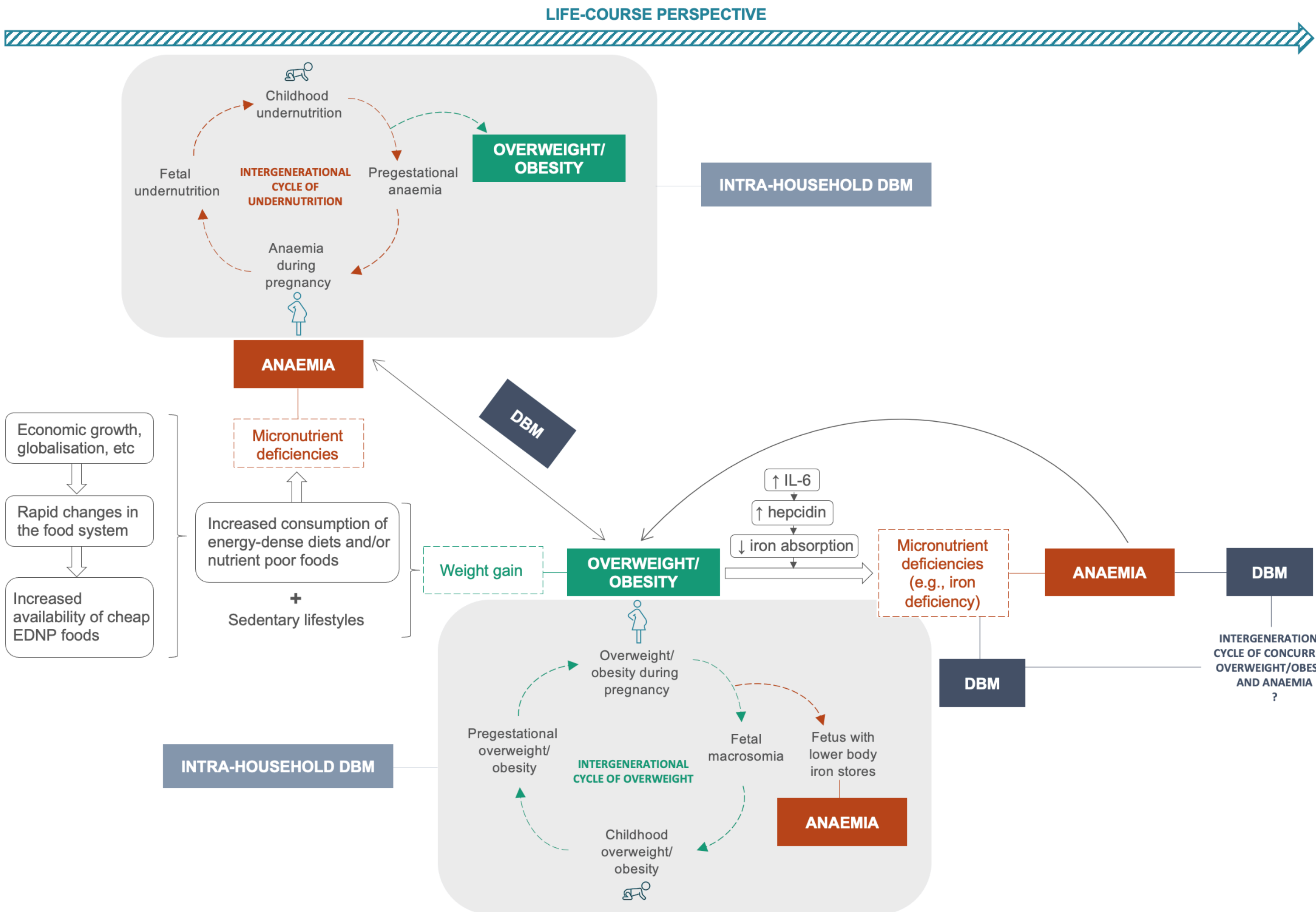
For this PhD thesis, the focus was on the coexistence of overweight/obesity and anaemia for multiple reasons stated throughout previous chapters, including: 1) the paucity of studies investigating this form of DBM and 2) to complement the findings from the Lancet Series on the DBM, whose focus was anthropometric data only (Popkin et al., 2020). Following the WHO definition, the possible combinations of the double burden of overweight/obesity and anaemia identified and used throughout this thesis encompassed: 1) overweight/obesity (population level); 2) anaemia (population level); 3) maternal overweight/obesity and childhood anaemia (household level); 4) maternal anaemia and childhood overweight/obesity (household level); 5) concurrent overweight/obesity and anaemia (individual level). Further, in an attempt to provide with a comprehensive analysis of the DBM, the population of interest for the DBM at the population and individual levels were adult women (20-49 years old), adolescent girls (15-19 years old) and children (0-59 months). Separate estimates for adult women and adolescent girls allowed to explore for differences in DBM between both groups, as opposed to the more conventional group normally investigated in DBM studies: WRA (15-49 years old) (Williams et al., 2020). Despite this, other groups, including male adolescents or adults (15-49 years old) were not included in the population and individual-level analyses, since data on combined within-individual overweight/obesity and anaemia are rare in DHS for men. At the individual level, the prevalence of concurrent overweight/obesity and anaemia has been calculated in a cross-sectional study conducted in Greater Tunis, Tunisia (Traissac et al., 2016). In the latter study, the intra-individual DBM prevalence among males seemed to be significantly lower than that among their female counterparts (men: 3.4% vs. women: 21.4%); even lower than expected when comparing separate estimates of both forms of malnutrition at the population level (Traissac et al., 2016). Whether this finding can be generalised to the wider LMIC context is something that remains unknown. Further studies from different countries across the globe are needed to confirm the latter. Likewise, at the household level, the DBM was only quantified using data from mothers (15-49 years old) and their children (0-59 months), without having into account other direct family members (i.e., fathers) or extended family (i.e., grandparents, aunts/uncles, cousins, etc.), who might live together under the same roof. To this end, it is likely that the estimates presented in this thesis are an underestimation of the true magnitude of the household-level DBM, as with previous evidence (Popkin et al., 2020). Furthermore, a “total-household DBM” estimate was computed for this thesis, in an effort to quantify the overall intra-household DBM, but this only included overweight/obesity and anaemia, excluding other equally prevalent forms of malnutrition in LMICs (e.g., stunting, wasting, thinness).

9.4.3. Life-course and intergenerational manifestation of the DBM

The WHO definition acknowledges that the DBM can manifest in two temporal dimensions (WHO, 2017a). For example, within individuals, one can be simultaneously affected by two or more forms of malnutrition, or develop multiple types over a lifetime (Hoffman et al., 2000; Wells et al., 2020). At the household level, parental malnutrition can be passed down to future generations; the so-called "intergenerational cycles of malnutrition" (Darnton-Hill et al., 2004; Duggal & Petri, 2018; Wells et al., 2020). The cross-sectional nature of the DHS data used in this thesis hinders exploring the life-course perspective of the double burden of overweight/obesity and anaemia, since individuals are not followed up over time. Longitudinal data (e.g., from cohort studies) might be more appropriate to help elucidate the complex relationship between these two forms of malnutrition (Cepeda-Lopez & Baye, 2020).

A simplified diagram summarising the links between overweight/obesity and anaemia from a nutritional perspective is displayed in **Figure 9.2**. Rapid changes in food systems, driven by factors such as economic growth, globalisation and urbanisation, and characterised by an increased availability of energy-dense nutrient poor (EDNP) foods are one of the major factors of malnutrition in all its forms (Development Initiatives, 2021). Overweight/obesity has also been previously linked to iron deficiency (Cepeda-Lopez et al., 2010; Cepeda-Lopez et al., 2015; Zheng et al., 2020), which can co-occur within individuals regardless of dietary iron intake (Cepeda-Lopez et al., 2011). Different hypotheses for the association between overweight/obesity and iron deficiency have been investigated and are summarised somewhere else (Cepeda-Lopez, 2015). In brief, obesity, characterised by chronic low-grade inflammation (↑ IL-6), increases hepcidin (an iron-regulating peptide hormone), reducing intestinal iron absorption, and eventually, leading to systemic iron deficiency and/or iron restricted erythropoiesis (Nemeth et al., 2004; Cepeda-Lopez et al., 2015; Mujica-Coopman et al., 2015). The link between overweight/obesity and anaemia or iron-deficiency anaemia is less clear; although iron deficiency can develop into anaemia over time (Tussing-Humphreys et al., 2012). Multiple studies have consistently found an association between overweight/obesity and the features of anaemia of inflammation (e.g., ↑ serum ferritin and ↓ serum iron); yet, haemoglobin

Figure 9.2. Diagram showing the interconnections between overweight/obesity and anaemia.



Note: This figure was designed by the author (Ana Irache) for the purposes of this PhD thesis.

levels do not seem to be significantly different in individuals living with overweight/obesity when compared to those with normal weight (Ausk & Ioannou, 2008). In Chapter 2 of this thesis, it was concluded that the studies included in the overview of the literature yielded mixed results with regards to the association between overweight/obesity and anaemia; however, there was a larger inclination towards an independence of both forms of malnutrition. Occasionally, this led to underestimate the magnitude and consequences of the DBM. The latter studies used cross-sectional data to investigate the association between overweight/obesity and anaemia, which does not take into account "time" as a factor (i.e., disease progression), nor changes towards a healthier nutritional status over time within individuals.

In addition, intergenerational cycles of malnutrition are also displayed in **Figure 9.2**, exploring how overweight/obesity and anaemia might coexist within households. Maternal pregestational overweight/obesity has been hypothesised to increase the risk of childhood anaemia (Phillips et al., 2014; Jones et al., 2016b; Wawer et al., 2021). A recent prospective study that followed up pregnant women and their infants to 6 months of age from three different countries (Switzerland, Mexico and Thailand), found that, when compared to pregnant women with normal weight, those with overweight/obesity failed to upregulate iron absorption in late pregnancy, transferred less iron to their fetus, and their infants had lower body iron stores (Stoffel et al., 2022). Likewise, maternal obesity increases the risk of fetal macrosomia, which in turn, may lead to inflammation, a rise in hepcidin levels, and over time, result in anaemia of inflammation (Ovesen et al., 2011; Wawer et al., 2021). The intergenerational consequences of women who have concurrent overweight/obesity and anaemia at pregnancy, are likely to be similar (or perhaps more severe) to those observed among women living with overweight/obesity only. Alternatively, undernutrition during pregnancy (including anaemia or micronutrient deficiencies) can result in low birth weight (Rahman et al., 2016; Figueiredo et al., 2018; Figueiredo et al., 2019). Children who experience undernutrition early on, are at a higher risk of developing overweight/obesity later in life, particularly in the context of obesogenic environments and the rapid nutrition transition (Hoffman et al., 2000; Victora et al., 2008; Wells et al., 2020).

9.4.4. Using anaemia as a proxy for micronutrient deficiencies

Throughout this thesis, anaemia was used as a proxy for micronutrient deficiencies, to quantify the DBM, in the absence of objective data on specific nutritional deficiencies. In DHS, testing of some micronutrient deficiencies is conducted, although not routinely, and the data is scarce: vitamin A testing (n=3 countries), vitamin D3 testing (n=2 countries), urine iodine excretion (n=2 countries), iodine salt testing (n=72 countries), serum vitamin B12 (n=1 country), serum folate (n=1 country), micronutrient testing (n=3 countries), iron transferrin receptor (n=1 country). To some extent, this is an important limitation of this thesis, which has been highlighted in the empirical chapters.

Anaemia is defined as a condition in which haemoglobin concentration and/or the number of red blood cells are lower than normal; and thus, insufficient to meet an individual's physiological needs (WHO, 2011; WHO, 2014b). The aetiology of anaemia is multifactorial including (Chaparro & Suchdev, 2019):

- Nutritional deficiencies: iron, vitamins A, B12, B6, C, D, and E, folate, riboflavin, copper, and zinc.
- Malnutrition: undernutrition and overweight/obesity.
- Disease/infection: anaemia of chronic disease or inflammation, soil-transmitted helminth infections, schistosomiasis, malaria, HIV, tuberculosis.
- Genetic disorders: sickle-cell disorders and thalassemias.

In this context, and since DHS does not collect data on the causes of anaemia, it was not possible to determine with full certainty whether anaemia was the result of nutritional deficiencies or malnutrition. Further, although iron deficiency has been long assumed to be the main contributor of anaemia cases globally (approximately 50% of all cases) (Stoltzfus et al., 2004; Iglesias-Vázquez et al., 2019), more recent evidence suggests that the proportion of anaemia due to iron deficiency differs by population group, geographical setting, infectious disease burden, and the prevalence of other anaemia causes (Petry et al., 2016; Engle-Stone et al., 2017; Wirth et al., 2017).

Given the complex aetiology of anaemia, further studies elucidating the context-specific causes of anaemia across different populations is warranted to implement interventions based on a country's needs. To this end, there is also a need to develop comprehensive surveys that include, not only anthropometric and anaemia data, but also harmonised indicators that allow to measure specific micronutrient deficiencies, as well as other causes of anaemia (SPRING, 2017).

9.5. Public health relevance

Double burdens represent an important public health challenge, particularly in LMICs with limited resources to address malnutrition; but also, a unique opportunity to address multiple forms simultaneously and accelerate action towards achieving the 2025 global nutrition targets and the 2030 goal of "ending malnutrition in all its forms" (WHO, 2014a; UN, n.d.a). Historically, malnutrition has been synonymous with hunger and undernutrition; while overweight/obesity was regarded as a distinct problem characterised by affluence, dietary richness, and sedentary behaviour. As a result, different forms of malnutrition have been researched and addressed in the main following silos: 1) chronic or acute undernutrition and energy inadequacy, 2) micronutrient deficiencies (sometimes within undernutrition), or 3) overweight, obesity, and dietary excess (Scrinis, 2020). Accumulating evidence (including this thesis), however, point to a "new nutrition reality" of a coexistence of multiple forms of malnutrition within individuals, households and populations (WHO, 2017a; Popkin et al., 2020; Wells et al., 2020; Development Initiatives, 2021). Unfortunately, the global health community has been slow to acknowledge the DBM across LMICs, and therefore, the siloed approach has led to narrow technical solutions, resulting in some cases, in unintended consequences (e.g., a rise in overweight/obesity) (Hawkes et al., 2020).

The results presented in this thesis call for raising awareness of the coexistence of overweight/obesity and anaemia at the three levels, particularly at the individual and household levels. At the individual level, the DBM was common in adult women (20-49 years), with prevalence estimates as high as 30% in Maldives, Jordan and Gabon. Nevertheless, important variations in the burden of intra-individual DBM were observed in this thesis for the three age groups; thus, actions towards reducing malnutrition in all its forms should be context-specific. Moreover, although the consequences of concurrent overweight/obesity and anaemia remain poorly understood, given 1) the harmful consequences (including intergenerational) of both separate forms and 2) the upward trend observed for the DBM and overweight/obesity only in most LMICs, indicate that women living with obesity should be screened and treated for anaemia and/or micronutrient deficiencies. To this end, from a life-course perspective, addressing adolescent girls might even have more beneficial effects, both, by 1) promoting healthy lifestyles and diets and 2) preventing overweight/obesity from developing (or stopping disease progression) before they become adult women. The latter is especially relevant, since addressing overweight/obesity and anaemia when both forms are present within individuals might be particularly challenging. Likewise, despite the overall low prevalence of concurrent overweight/obesity and anaemia among children, identifying the intra-individual DBM early on could prevent the detrimental effects that both forms of malnutrition have on health. Malnutrition in early childhood can lead to poor growth and cognitive development, and an increased risk of nutrition-related NCDs later in life (Elias et al., 2003; McCann, 2007; Li et al., 2008; Wells et al., 2020). Addressing the DBM at the individual and population levels will likely lead to a decrease in intra-household DBM, by breaking the intergenerational cycles of overweight/obesity and anaemia identified in **Figure 9.2**. Further, changes in the broader food systems need to be considered; otherwise, targeting the proximal determinants of malnutrition alone will only have a limited effect (Wells et al., 2021). Food systems influence food environments, defined as “the place or places where consumers interact with the food system to buy and consume food”, by influencing food availability, quality, safety, and affordability (Herforth & Ahmed, 2015; Swinburn et al., 2015; Turner et al., 2018; Fanzo et al., 2021). In this context, food systems that are not conducive of healthy food environments will negatively impact the health and nutrition status of populations (HLPE, 2017).

In order to address malnutrition in all its forms, the *Lancet Series on the Double Burden of Malnutrition* highlighted a list of ten double-duty actions (Hawkes et al., 2020). Double-duty actions are policies, interventions and programmes that have the potential to simultaneously address both, undernutrition and overweight/obesity; and are based on the rationale that “opposing” forms of malnutrition share common drivers, such as early life nutrition, diet quality, food environments and socioeconomic factors (Dietz et al., 2017; Hawkes et al., 2017; WHO, 2017a; WHO, 2017c; Demaio & Branca, 2018; Pradeilles et al., 2019; Hawkes et al., 2020). The list of double-duty actions and how these have potential to address overweight/obesity and anaemia are presented in **Table 9.1**.

Table 9.1. List of double-duty actions (DDA) as proposed by Hawkes et al., 2020.

DDA1	**Scale up new WHO antenatal care recommendations**
	Counselling and promotion of healthy eating (quality and quantity) and keeping physically active during pregnancy, as well as carefully monitor targeting of protein and energy supplements, will prevent excessive weight gain and risk of developing iron deficiency or anaemia. In vulnerable populations, initiatives to reduce undernutrition are recommended to reduce the risk of low birth weight.
	Recommendation: *This should be expanded to cover the pre-pregnancy and post-pregnancy periods (e.g., monitor women who are living with overweight/obesity and screen for micronutrient deficiencies to reduce the incidence of pre-gestational overweight/obesity and maternal anaemia; which in turn, will break the intergenerational cycle of malnutrition). Women who enter pregnancy with overweight/obesity and anaemia might not be able to keep physically active and it might be particularly challenging to treat anaemia.*
DDA2	**Scale up programmes to protect, promote, and support breastfeeding**
	This includes exclusive breastfeeding for 6 months and continued breastfeeding up to age 24 months or beyond, early initiation of breastfeeding, and eliminating the promotion of breastmilk substitutes. Breastfeeding has been identified as a protective factor against childhood obesity and NCDs later in life, helps prevent undernutrition, and has also important benefits for lactating mothers (e.g., regulation of weight gain in the postpartum period, acting as a protective factor for obesity and NCDs later in life) (Yan et al., 2014; Horta et al., 2015; Victora et al., 2016).
	Recommendation: *Additionally, paid maternity leave and family-friendly policies at the workplace might help protect and support breastfeeding.*
DDA3	**Redesign guidance for complementary feeding practices and related indicators**
	The promotion of healthy and diverse diets, including daily intake of vegetables and fruits; while avoiding unhealthy foods, snacks, and beverages high in energy, sugar, fat and salt is paramount to prevent overweight/obesity and micronutrient deficiencies.
DDA4	**Redesign existing growth monitoring programmes**
	Ongoing growth monitoring programmes follow WHO indicators to measure all forms of malnutrition among children and include appropriate referral and follow-up.
	Recommendation: *If feasible, programmes could include testing for micronutrient deficiencies and/or anaemia. Moreover, existing growth monitoring programmes could be expanded to monitor all forms of malnutrition among WRA/mothers.*
DDA5	**Prevent undue harm from energy-dense and micronutrient-fortified foods and ready to use supplements**
	Healthy diets should be the default measure to prevent all forms of malnutrition. The widespread distribution of energy-dense and micronutrient-fortified foods and supplements have, on some occasions, caused unintended consequences, including overweight/obesity (Ford et al., 2018).
	Recommendation: *The effect of current initiatives to reduce anaemia (e.g., iron-deficiency anaemia) need to be evaluated in the context of increased rates in overweight/obesity and the intra-individual double burden of overweight/obesity and anaemia.*
DDA6	**Redesign cash and food transfers, subsidies, and vouchers**
	Social safety nets programmes need to be redesigned to promote the consumption of nutritious foods and avoid unhealthy food choices (e.g., ultra-processed foods) to help prevent weight gain and the DBM. To achieve the latter, it is recommended that programmes include education and behaviour change communication components, as well as regular health check-ups (e.g., monitoring of nutritional status) for all household members.

Table 9.1. (continued)

DDA7	**Redesign school feeding programmes and devise new nutritional guidelines for food in and around educational institutions**
	School feeding programmes that follow food and nutrition guidelines, promote healthy food environments by eliminating the promotion and sale of foods, snacks, and beverages high in energy, sugar, fat, and salt, and incorporate activities that build knowledge and skills around healthy eating/nutrition (e.g., school gardens).
	Recommendation: *School feeding programmes should extend to cover day care, pre-schools and high-schools and include, where appropriate, plans to incorporate access to safe drinking water and hygiene practices, to reduce the spread of infectious diseases.*
DDA8	**Scale up nutrition-sensitive agriculture programmes**
	Nutrition-sensitive agriculture programmes that address malnutrition in all its forms include approaches to promote diversity in food production and consumption at home (e.g., home gardens) or communities (e.g., community gardens) among vulnerable households and areas (rural and urban), and to empower women in agricultural programmes.
DDA9	**Design new agricultural and food system policies to support healthy diets**
	Actions within agriculture towards the production of nutritious foods (e.g., fruits, vegetables, nuts, legumes and wholegrains) and food systems to ensure that these food products are available and affordable for individuals to buy and consume, will contribute to a higher intake of healthy diets.
DDA10	**Implement policies to improve food environments from the perspective of malnutrition in all its forms**
	In order to promote healthy eating, it is imperative for countries to develop, adopt and implement strong policies against unhealthy products and/or practices such as: 1) eliminate the promotion of breastmilk substitutes and follow-on formula; 2) reduce the marketing of foods, snacks and beverages that are EDNP; 3) tax foods, snacks and beverages that are EDNP; 4) set incentives and rules for retailers and traders to ensure healthier food environments.

Additionally, a summary of recommendations for practice and policy discussed in this thesis are highlighted in the box below:

RECOMMENDATIONS FOR PRACTICE AND POLICY

- Policy makers and health care professionals should recognise the coexistence of overweight/obesity and anaemia as an important public health issue, particularly their co-occurrence among adult women at the individual level.
- There is a need to reach a consensus with regards to the operational DBM definitions to be used to guide research and the development of policies and programmes. This should include anaemia and/or micronutrient deficiencies.
- The Demographic and Health Surveys (DHS) programme, as well as similar large nationally representative surveys, should consider collecting anaemia (and/or micronutrient deficiencies) data alongside anthropometric measurements routinely. This will help with monitoring the magnitude and trends of all forms of malnutrition and their coexistence at multiple levels and to propose a roadmap for action at country-levels accordingly.

- Anaemia (and/or micronutrient deficiencies) data should always be used, if available, when aiming to quantify the magnitude and distribution of the DBM. The opposite will result in an underestimation of the full extent of malnutrition.
- Monitoring of the causes of anaemia at the country-level and across different population subgroups is needed.
- Policies and programmes that are “double-duty” should be widely endorsed in countries to accelerate action towards reducing all forms of malnutrition (e.g., food systems transformations); but particularly in urban areas, where the burden of overweight/obesity and anaemia seem to be the highest.
- Policy makers should consider targeting adolescents and children in schools before reaching adulthood to prevent forms of malnutrition from being passed on to the next generations.

9.6. Implications for future research

Possible future directions for research have been discussed and highlighted in previous chapters. Based on the findings presented and the gaps identified, areas that merit further exploration include the following:

1) A better understanding of how the coexistence of overweight/obesity and anaemia manifest throughout the life-course and across generations.
2) A better understanding on how unhealthy diets, including ultra-processed foods, mediate the coexistence of overweight/obesity and anaemia.
3) A better understanding of the health consequences of concurrent overweight/obesity and anaemia, particularly at critical life stages, including childhood and pregnancy.
4) Evaluation of the effectiveness of existent strategies to reduce anaemia among women living with overweight/obesity, and identification of interventions that might be more effective at reducing the intra-individual double burden of overweight/obesity and anaemia.
5) A better understanding of the causes of anaemia in different LMICs for the different population groups.
6) A better understanding of sex differences in the co-occurrence of overweight/obesity and anaemia among the adult population.

7) An exploration of the magnitude of the double burden of overweight/obesity and anaemia at the individual and household levels by regions/states within countries, as well as by other relevant sociodemographic characteristics (e.g., ethnic groups, religious groups, occupation status, etc.).
8) Documentation of trends in the double burden of overweight/obesity and anaemia at the household level (e.g., maternal overweight/obesity and childhood anaemia) and individual level among adolescent girls and children.
9) Critical evaluation of nutrition policies/programmes being currently implemented in countries and propose recommendations that are double-duty, accordingly.

9.7. Conclusion

Anaemia remains an important public health problem in LMICs; while overweight/ obesity is rising rapidly, resulting in multiple forms of malnutrition coexisting within individuals, households, and at the population level. This thesis provided a comprehensive analysis of the double burden of overweight/obesity and anaemia among adult women, adolescent girls and children living in LMICs, by use of data from nationally representative household-based surveys (DHS data).

Overall, the intra-individual DBM was common among adult women and low among children under-5. The intra-household DBM was high, primarily driven by the form maternal overweight/obesity and childhood anaemia. Important differences in DBM magnitude were identified by sociodemographic characteristics, with higher prevalence estimates among those in the higher wealth quintiles, higher (maternal) education levels, and in urban areas, for the intra-individual DBM among adult women and adolescent girls, and maternal overweight/obesity and childhood anaemia. Little differences across population subgroups were observed for the intra-individual DBM among children, and maternal anaemia and childhood overweight/obesity. The trend analysis yielded a modest increase in the intra-individual DBM among adult women from 2000 to 2019, which occurred in parallel with an overall upward trend in overweight/obesity and a downward trend in anaemia. Moreover, the intra-individual DBM among adult women increased faster in the three middle wealth groups, women with no education and those living in capital cities or rural areas.

The data presented in this thesis can be used by policy makers to inform double-duty actions and accelerate progress to achieve the 2025 global nutrition targets. Due to the high heterogeneity of results obtained for the different LMICs, recommendations to address the DBM should be context-specific. Further, the findings point to the recognition of overweight/obesity as a potential driver of anaemia. Future research that investigates the double burden of overweight/obesity and anaemia using longitudinal data might help better elucidate the latter. In countries where DBM prevalence estimates were high, or are experiencing a rapid increase in overweight/obesity, should carefully consider testing adult women living with overweight/ obesity for anaemia (or specific micronutrient deficiencies). Likewise, the effectiveness of interventions currently in place to address anaemia in LMICs should be tested in the context of the intra-individual DBM. Lastly, given the complex aetiology of anaemia, further studies elucidating context-specific causes across different populations is warranted to implement interventions based on a country's needs.

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Appendix A

Additional Information for Chapter 4:

Methods

A.1. Proof of access to DHS data

Apr 01, 2019

Ana Irache
University of Warwick
United Kingdom
Phone:
Email: Ana.Irache@warwick.ac.uk
Request Date: 03/30/2019

Dear Ana Irache:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Nutrition status in low-and middle-income countries":

> **Afghanistan, Albania, Angola, Armenia, Azerbaijan, Bangladesh, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Chad, Colombia, Comoros, Congo, Congo Democratic Republic, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guatemala, Guinea, Guyana, Haiti, Honduras, India, Indonesia, Jordan, Kazakhstan, Kenya, Kyrgyz Republic, Lesotho, Liberia, Madagascar, Malawi, Maldives, Mali, Mauritania, Mexico, Moldova, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Nigeria (Ondo State), Pakistan, Paraguay, Peru, Philippines, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, South Africa, Sri Lanka, Sudan, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, Uzbekistan, Vietnam, Yemen, Zambia, Zimbabwe**

For restricted surveys, you must also request special permission from the Implementing Agencies. If approved, the restricted datasets will be provided to you by FTP.

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. Users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: archive@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

A.2. Datasets included for the analyses

Country	Individual recode files (IR)				Children recode files (KR)			
	C5	C6	C7	C8	C5	C6	C7	C8
AFRICAN REGION								
Angola					X		X	
Benin	X	X	X	X	X		X	
Burkina Faso	X	X	X	X	X		X	
Burundi	X	X	X	X	X		X	
Cameroon	X	X	X	X	X		X	
Congo	X	X	X	X	X		X	
Cote d'Ivoire	X	X	X		X		X	
Democratic Republic of the Congo	X	X	X	X	X		X	
Eswatini	X	X	X		X		X	
Ethiopia	X	X	X	X	X		X	
Gabon	X	X	X		X		X	
Gambia	X	X	X	X	X		X	
Ghana	X	X	X	X	X		X	
Guinea	X	X	X	X	X		X	
Lesotho	X	X	X	X	X		X	
Madagascar	X		X	X	X		X	
Malawi	X	X	X	X	X		X	
Mali	X	X	X	X	X		X	
Mozambique	X	X	X		X		X	
Namibia	X	X	X		X		X	
Niger	X	X	X	X	X		X	
Nigeria	X	X	X		X		X	
Rwanda	X	X	X	X	X		X	
Sao Tome and Principe	X	X	X		X		X	
Senegal	X	X	X	X	X		X	
Sierra Leone	X	X	X	X	X		X	
South Africa	X	X	X		X		X	
Tanzania	X	X	X	X	X		X	
Togo	X	X	X		X		X	
Uganda	X	X	X	X	X		X	
Zimbabwe	X	X	X	X	X		X	

Country	Individual recode files (IR)				Children recode files (KR)			
	C5	C6	C7	C8	C5	C6	C7	C8
EASTERN MEDITERRANEAN REGION								
Egypt	X	X	X	X	X		X	
Jordan	X		X	X	X		X	
Yemen	X	X	X		X		X	
EUROPEAN REGION								
Albania	X	X	X	X	X		X	
Armenia	X	X	X	X	X		X	
Azerbaijan	X	X	X		X		X	
Kyrgyz Republic	X	X	X		X		X	
Moldova	X	X	X		X		X	
Tajikistan	X	X	X		X		X	
AMERICAS REGION								
Bolivia	X	X	X	X	X		X	
Guatemala	X	X	X		X		X	
Guyana	X	X	X		X		X	
Haiti	X	X	X	X	X		X	
Honduras	X	X	X	X	X		X	
Peru	X	X	X	X	X		X	
SOUTHEAST ASIAN REGION								
India	X	X	X	X	X		X	
Maldives	X	X	X		X		X	
Myanmar	X	X	X		X		X	
Nepal	X	X	X	X	X		X	
Timor-Leste	X	X	X	X	X		X	
WESTERN PACIFIC REGION								
Cambodia	X	X	X	X	X		X	

Note: Crosses indicate the type of DHS dataset employed in the analysis for C5 (Chapter 5), C6 (Chapter 6), C7 (Chapter 7) and C8 (Chapter 8). For C5, C6 and C7, at least one dataset with available anthropometric and anaemia values was needed. For C8, countries selected are those with at least two available datasets with anthropometric and anaemia values from two different time points. In IR recodes, women of reproductive age (15-49 years old) are the unit of analysis; whereas in KR recodes, children (0-5 years old) are the unit of analysis.

A.3. STROBE guidelines for Chapter 5

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	xx and 74
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	xx
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	pp 1-5 and pp 43-44
Objectives	3	State specific objectives, including any prespecified hypotheses	pp 46-47 and 74
Methods			
Study design	4	Present key elements of study design early in the paper	pp 49-73
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	pp 53-54
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	pp 55-56
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	pp 57-67
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	pp 49-73
Bias	9	Describe any efforts to address potential sources of bias	pp 49-73
Study size	10	Explain how the study size was arrived at	pp 56
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	pp 57-67
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	pp 68-70
		(*b*) Describe any methods used to examine subgroups and interactions	pp 68-70
		(*c*) Explain how missing data were addressed	pp 57-70 and 74
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	pp 56 and pp 74-87
		(b) Give reasons for non-participation at each stage	pp 56 and 61
		(c) Consider use of a flow diagram	pp 56
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	pp 75-87
		(b) Indicate number of participants with missing data for each variable of interest	pp 56 and 74
Outcome data	15*	Report numbers of outcome events or summary measures	pp 89-173
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	pp 89-173
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a

	Item No	Recommendation	Page No
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	pp 89-173
Discussion			
Key results	18	Summarise key results with reference to study objectives	pp 174-176
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	pp 176-177
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	pp 174-176 and 177-179
Generalisability	21	Discuss the generalisability (external validity) of the study results	pp 176-177
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	xvi

A.4. STROBE guidelines for Chapter 6

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	xx and 181
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	xx
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	pp 1-5 and pp 43-44
Objectives	3	State specific objectives, including any prespecified hypotheses	pp 46-47 and 181
Methods			
Study design	4	Present key elements of study design early in the paper	pp 49-73
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	pp 53-54
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	pp 55-56
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	pp 57-67
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	pp 49-73
Bias	9	Describe any efforts to address potential sources of bias	pp 49-73
Study size	10	Explain how the study size was arrived at	pp 56
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	pp 57-67
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	pp 68-70
		(*b*) Describe any methods used to examine subgroups and interactions	pp 68-70
		(*c*) Explain how missing data were addressed	pp 57-70 and 181
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	pp 56 and pp 181-190
		(b) Give reasons for non-participation at each stage	pp 56 and 61
		(c) Consider use of a flow diagram	pp 56
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	pp 181-190
		(b) Indicate number of participants with missing data for each variable of interest	pp 56
Outcome data	15*	Report numbers of outcome events or summary measures	pp 190-245
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	pp 190-245
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a

	Item No	Recommendation	Page No
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	pp 190-245
Discussion			
Key results	18	Summarise key results with reference to study objectives	pp 246-248
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	pp 248-249
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	pp 246-248 and 249-250
Generalisability	21	Discuss the generalisability (external validity) of the study results	pp 248-249
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	xvi

A.5. STROBE guidelines for Chapter 7

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	xx and 252
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	xx
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	pp 1-5 and pp 43-44
Objectives	3	State specific objectives, including any prespecified hypotheses	pp 46-47 and 252
Methods			
Study design	4	Present key elements of study design early in the paper	pp 49-73
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	pp 53-54
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	pp 55-56
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	pp 57-67
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	pp 49-73
Bias	9	Describe any efforts to address potential sources of bias	pp 49-73
Study size	10	Explain how the study size was arrived at	pp 56
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	pp 57-67
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	pp 68-70
		(*b*) Describe any methods used to examine subgroups and interactions	pp 68-70
		(*c*) Explain how missing data were addressed	pp 57-70
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	pp 56, 74-87 and 181-190
		(b) Give reasons for non-participation at each stage	pp 56 and 61
		(c) Consider use of a flow diagram	pp 56
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	pp 75-87 and pp 181-190
		(b) Indicate number of participants with missing data for each variable of interest	pp 56
Outcome data	15*	Report numbers of outcome events or summary measures	pp 252-272
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	pp 252-272
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a

	Item No	Recommendation	Page No
Discussion			
Key results	18	Summarise key results with reference to study objectives	pp 273-274
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	pp 274-275
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	pp 273-275
Generalisability	21	Discuss the generalisability (external validity) of the study results	pp 273-275
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	xvi

A.6. STROBE guidelines for Chapter 8

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	xx and 277
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	xx
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	pp 1-5 and pp 43-44
Objectives	3	State specific objectives, including any prespecified hypotheses	pp 46-47 and 277
Methods			
Study design	4	Present key elements of study design early in the paper	pp 49-73
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	pp 53-54
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	pp 55-56
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	pp 57-67
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	pp 49-73
Bias	9	Describe any efforts to address potential sources of bias	pp 49-73
Study size	10	Explain how the study size was arrived at	pp 56
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	pp 57-67
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	pp 68 and 71
		(*b*) Describe any methods used to examine subgroups and interactions	pp 71
		(*c*) Explain how missing data were addressed	pp 57-70 and 277-278
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	pp 56 and pp 277-310
		(b) Give reasons for non-participation at each stage	pp 56 and 61
		(c) Consider use of a flow diagram	pp 56
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	pp 277-310
		(b) Indicate number of participants with missing data for each variable of interest	pp 56 and 277-310
Outcome data	15*	Report numbers of outcome events or summary measures	pp 311-335
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	pp 311-335
		(*b*) Report category boundaries when continuous variables were categorized	n/a

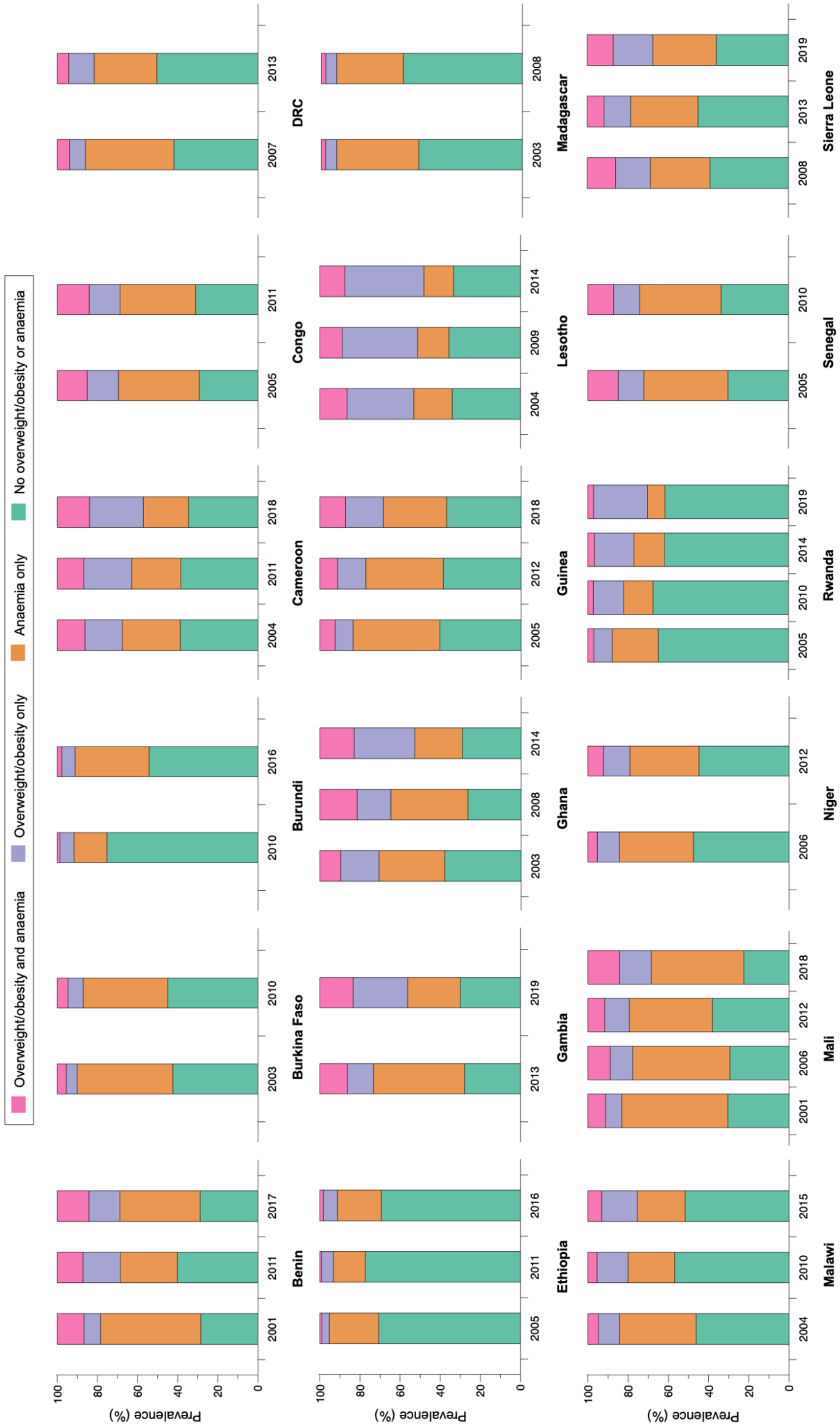
	Item No	Recommendation	Page No
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	pp 316 and 325
Discussion			
Key results	18	Summarise key results with reference to study objectives	pp 336-338
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	pp 339
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	pp 336-338 and 340
Generalisability	21	Discuss the generalisability (external validity) of the study results	pp 339
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	xvi

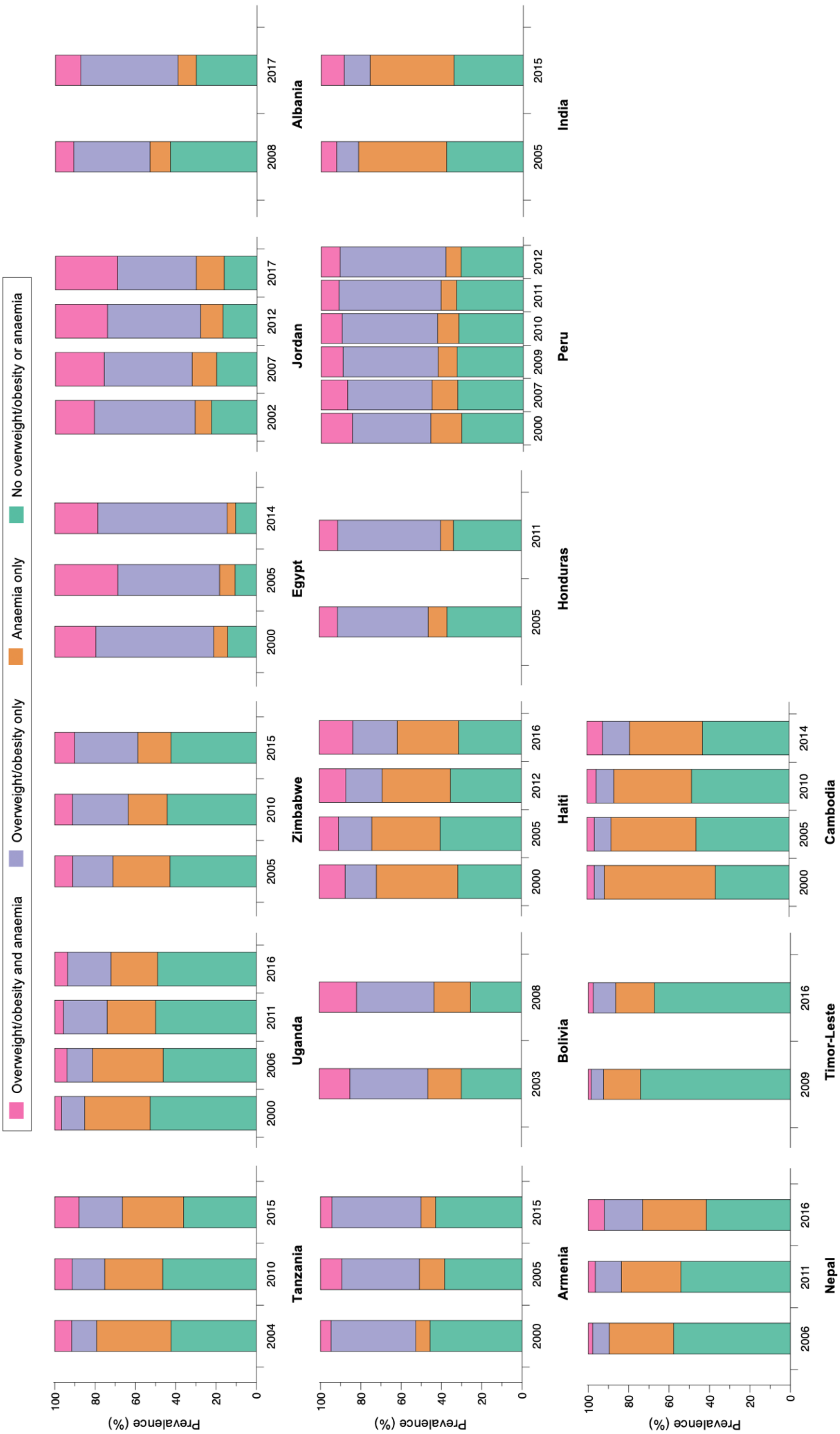
Appendix B

Additional Information for Chapter 8:

Trends in the magnitude and inequalities of the intra-individual double burden of overweight/ obesity and anaemia among non-pregnant adult women living in 33 low-and middle-income countries

B.1. Prevalence of overweight/obesity and anaemia in adult women (20-49 years)


Overweight/obesity and anaemia
Overweight/obesity only
Anaemia only
No overweight/obesity or anaemia
Prevalence (%)
Malawi
Benin
Ethiopia
Burkina Faso
Gambia
Mali
Burundi
Ghana
Niger
Cameroon
Guinea
Rwanda
Congo
Lesotho
Senegal
DRC
Madagascar
Sierra Leone


Overweight/obesity and anaemia
Overweight/obesity only
Anaemia only
No overweight/obesity or anaemia
Prevalence (%)
Tanzania
Uganda
Zimbabwe
Egypt
Jordan
Albania
Armenia
Bolivia
Haiti
Honduras
Peru
India
Nepal
Timor-Leste
Cambodia